

Nos. 22-16810, 22-16812

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United States Court of Appeals for the Ninth Circuit

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CITY OF OAKLAND, a Municipal Corporation; PEOPLE OF THE STATE OF CALIFORNIA, by and through the City Attorney for the City of Oakland; CITY AND COUNTY OF SAN FRANCISCO, a Municipal Corporation; PEOPLE OF THE STATE OF CALIFORNIA, acting by and through the San Francisco City Attorney,

*Plaintiffs-Appellees,*

v.

BP PLC, a public limited company of England and Wales; CHEVRON CORPORATION, a Delaware corporation; CONOCOPHILLIPS COMPANY, a Delaware corporation; CONOCOPHILLIPS; EXXON MOBIL CORPORATION, a New Jersey corporation; SHELL, PLC, a public limited company of England and Wales, f/k/a Royal Dutch Shell PLC,

*Defendants-Appellants.*

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Appeals from the United States District Court,  
Northern District of California,  
Nos. 3:17-cv-6011, 3:17-cv-6012 (Hon. William H. Alsup)

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**FURTHER EXCERPTS OF RECORD**

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# EXHIBIT 1

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CONTRACT NO. NOD-9930

WMF - Compare with WBEC  
Operating Agreement

See P. 3

JWW

OPERATING AGREEMENT

BETWEEN

NAVY DEPARTMENT AND STANDARD OIL COMPANY OF CALIFORNIA

RELATING TO

NAVAL PETROLEUM RESERVE NO. 1 (ELK HILLS)

DATED NOVEMBER 3, 1971

CONTRACT NO. NOD-9930

CONTRACT  
FOR THE OPERATION OF NAVAL PETROLEUM RESERVE NO. 1  
(ELK HILLS, CALIFORNIA)

THIS CONTRACT, entered into in quadruplicate on the 3rd day of November, 1971, by and between the UNITED STATES OF AMERICA acting by and through the Secretary of the Navy (hereinafter referred to as NAVY), and STANDARD OIL COMPANY OF CALIFORNIA (hereinafter referred to as OPERATOR or OPERATOR FOR NAVY), a corporation organized and existing under the laws of the State of Delaware, whose principal address is 225 Bush Street, San Francisco, California 94120.

WITNESSETH:

WHEREAS, NAVY has, by law, authority to:

- (1) Restrict production from the RESERVE to that minimum necessary to maintain it in a state of readiness to produce, thereby maintaining the present reserves of oil in the ground insofar as that is possible.
- (2) Conserve soil and wildlife, and promote good surface conservation practices,
- (3) Explore, prospect, develop, and/or operate all or any part of the RESERVE, directly or by contract,
- (4) Determine absolutely from time to time the rate of prospecting and development on, and the quantity and rate of production from the RESERVE, and
- (5) Select an operator to carry out a program of water injection as contemplated by the SOUTH FLANK WATER INJECTION and WEST END WATER INJECTION AGREEMENTS; and

WHEREAS, NAVY invited bids for an operator to carry out the operations authorized by law, upon notice and advertisement deemed proper by the Secretary of the Navy; and

WHEREAS, pursuant to Invitation for Bids No. 52, OPERATOR FOR NAVY submitted its bid which is Schedule B annexed hereto and made a part hereof and which contains warranties to induce NAVY to execute this contract;

WHEREAS, the UNIT PLAN CONTRACT provides that if any operating agreement is awarded to STANDARD at any time, it shall provide for the performance of the work thereunder at actual cost thereof to STANDARD;

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WHEREAS, in order to award an operating agreement to STANDARD providing for payment of other than actual costs would require a waiver of the restriction in the UNIT PLAN CONTRACT;

WHEREAS, the bid submitted by STANDARD is acceptable to NAVY; and

WHEREAS, the application of the third sentence in Section 3(a) of the UNIT PLAN CONTRACT, relating to performance of work at actual cost, is hereby waived for the effective duration of this Agreement;

NOW, THEREFORE, NAVY and OPERATOR FOR NAVY mutually agree as follows:

SECTION I. IDENTIFICATION OF OPERATOR.

Subject to the terms and conditions hereinafter set forth, Standard Oil Company of California is hereby appointed OPERATOR FOR NAVY of and for all lands and leases now or hereafter made subject to the UNIT PLAN CONTRACT, and SOUTH FLANK WATER INJECTION AGREEMENT and WEST END WATER INJECTION AGREEMENT.

SECTION II. DEFINITIONS.

- (a) RESERVE refers to Naval Petroleum Reserve No. 1, Kern County, California.
- (b) STANDARD means the Standard Oil Company of California, a Delaware corporation.
- (c) UNIT refers to the Unit Operation-Naval Petroleum Reserve No. 1, covering certain lands of NAVY and of STANDARD developed and operated as a unit in the manner and to the extent contemplated by the UNIT PLAN CONTRACT.
- (d) UNIT PLAN CONTRACT refers jointly to the contract so entitled between NAVY and STANDARD, numbered NOD-4219, dated June 19, 1944, and the Amendatory and Supplemental Agreement between the same parties, numbered NOD-8477, dated December 22, 1948.
- (e) SOUTH FLANK WATER INJECTION AGREEMENT refers to the contract so entitled between NAVY and STANDARD, numbered NOD-9242, dated June 28, 1957.
- (f) WEST END WATER INJECTION AGREEMENT refers to the contract so entitled between NAVY and STANDARD, numbered NOD-9783, dated October 25, 1965.
- (g) OPERATING COMMITTEE. That Committee, consisting of one STANDARD member and one NAVY member, which is charged, under the provisions of Section 3(b) of the UNIT PLAN CONTRACT, with supervision and direction of operations which are initiated and controlled in accordance with Sections 3 and 4 of the UNIT PLAN CONTRACT.

(h) OFFICER IN CHARGE. The "Officer in Charge" is that officer who is so designated by competent Navy Orders, or who is acting as Officer in Charge of the Naval Petroleum Reserves in California. The Officer in Charge is the representative in the field of the Director, Naval Petroleum and Oil Shale Reserves, and the Secretary of the Navy for the management of all operations, including the administration of this contract.

SECTION III. RELATIONSHIP BETWEEN OPERATOR, OPERATING COMMITTEE, AND OFFICER IN CHARGE.

(a) The OPERATOR is in the employ of the Navy Department and is responsible to the Secretary thereof through the Officer in Charge and the Director, Naval Petroleum and Oil Shale Reserves.

(b) The scope of the authority of the OPERATING COMMITTEE, for purposes of diligent performance of this Agreement by the OPERATOR FOR NAVY, is the supervision and direction of all of exploration, prospecting, development, and producing operations of the UNIT. In the supervision and direction of any such undertakings, the OPERATING COMMITTEE exercises the functions enumerated in Sections 3(b)(1) through 3(b)(5) of the UNIT PLAN CONTRACT and as enumerated in other subsequent agreements.

(c) OPERATOR personnel shall provide services as herein specified and required by the Officer in Charge or the OPERATING COMMITTEE as the case may be, and shall supply information to both the Officer in Charge and the OPERATING COMMITTEE regarding all operations under the UNIT PLAN CONTRACT.

(d) OPERATOR shall not, except for minor or routine functions, make compilations from UNIT records, research UNIT records, prepare operational studies, or do similar work for either Member of the OPERATING COMMITTEE without permission first had and obtained from the OPERATING COMMITTEE in writing. In giving such permission, the OPERATING COMMITTEE shall specify the requesting party and the manner in which it shall be charged on UNIT accounts.]

(e) OPERATOR shall not conduct any survey in any well-bore without prior concurrence of the OPERATING COMMITTEE.

(f) OPERATOR shall at all times keep the Officer in Charge and the OPERATING COMMITTEE fully informed as to matters under the OPERATOR'S cognizance.

(g) It is a condition of this Agreement and recognized as possible cause for termination pursuant to Section XIV hereof, that the OPERATOR not engage in any activity or oil field practice, on or off the RESERVE, which would conflict with NAVY'S responsibility and duty to conserve the maximum amount of oil and gas in place in a manner to achieve maximum ultimate recovery in any or all of NAVY'S Petroleum or Oil Shale Reserves, provided, however, that this will not interfere or restrict leasehold operations in Naval Petroleum Reserve No. 2, Buena Vista Hills. This condition includes,

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but is not limited to, activities of the OPERATOR, as a land owner, lessee, or operator on lands outside the Reserves which might affect lands within the Reserves.

SECTION IV. EXPLORATION, PROSPECTING, DEVELOPMENT AND OPERATION OF THE RESERVE.

(a) The OPERATOR shall perform, upon the terms and conditions hereinafter set forth, the work of exploring, prospecting, developing, and operating the lands of NAVY and STANDARD in the UNIT and the lands of NAVY outside the UNIT and the work required of the OPERATOR under the SOUTH FLANK WATER INJECTION AGREEMENT and WEST END WATER INJECTION AGREEMENT and such other agreements pertaining to the UNIT as NAVY may from time to time enter into.

(b) The OPERATOR shall furnish, except as otherwise defined herein, at OPERATOR'S initial expense, subject to reimbursement as provided for in Section VII hereof, materials, supplies, equipment, machinery, tools, facilities, labor, and services required in connection therewith.

(c) At NAVY'S discretion, NAVY may undertake, by separate contract or otherwise, any supplemental operations as it may deem necessary or advisable to augment or complement OPERATOR'S activities, and any function herein assigned to OPERATOR may, at NAVY'S election, be performed by NAVY or by contract personnel.

(d) OPERATOR shall perform on NAVY'S behalf, directly or by subcontract, such operations, including the acquisition of materials and the construction of new facilities, as may be necessary to enable NAVY to receive and dispose of its share of the production from the RESERVE and to operate those portions of the RESERVE not part of the UNIT, and as may be necessary to enable NAVY to maintain facilities and an administrative office on the RESERVE. The OPERATOR shall, subject to OPERATOR'S prior consent in each instance, perform on NAVY'S behalf, directly or by subcontract, such operations as the Officer in Charge may request relating to Naval Petroleum Reserve No. 2.

(e) The exploration, prospecting, development, and operation of the UNIT and of the RESERVE outside the UNIT, and the injection of salt water into sands on the south flank and west end of the RESERVE, pursuant to the UNIT PLAN CONTRACT, the SOUTH FLANK WATER INJECTION AGREEMENT and WEST END WATER INJECTION AGREEMENT, and such other agreements as NAVY may from time to time enter into, shall include, without being limited thereto, the following functions:

- (1) The drilling of wells, including water and gas injection wells, which are drilled at the direction of NAVY.
- (2) The deepening, redrilling, repairing, and cleaning-out of wells.
- (3) Exploration and prospecting.
- (4) The shutting-in and/or abandonment of wells.

(5) The production of oil, gas, natural gasoline, and associated hydrocarbons from the UNIT and from the RESERVE outside the UNIT under all conditions as to rate of production by primary and other methods, provided, however, that monitoring and testing of oil delivered to NAVY and to STANDARD will be witnessed jointly by representatives of NAVY and STANDARD. Monitoring and testing of oil delivered to NAVY from NAVY non-UNIT production will be witnessed by representatives of NAVY designated by the Officer in Charge.

(6) The processing of wet gas for the recovery of natural gasoline and other hydrocarbons and the injection of gas and liquids into producing formations.

(7) The furnishing, or acquiring as purchasing agent for the UNIT, for NAVY, or for NAVY and STANDARD under the SOUTH FLANK WATER INJECTION AGREEMENT and the WEST END WATER INJECTION AGREEMENT of machinery, equipment, materials, tools, supplies, facilities, labor, services, plus construction and maintenance of structures and facilities required for the performance of work hereunder.

(8) The gathering, treatment, storage, and transportation on the RESERVE of oil, gas, natural gasoline, and associated hydrocarbons produced from the RESERVE.

(9) The maintenance of all RESERVE surface and subsurface facilities and equipment including roads, pipelines, power lines, and buildings.

(10) The establishment and implementation of a maintenance management program at Elk Hills similar to the one now in being at Elk Hills. The planned program applies the principles of continuous inspection, work planning, material control, scheduling and performance measurements to the complex problem of facilities maintenance.

(f) OPERATOR shall furnish to the Officer in Charge and to the OPERATING COMMITTEE a set of field operating procedures that are commensurate with the State of California laws and good oil field practice within six (6) months of the effective date of this contract.

(g) OPERATOR agrees that it will retain necessary employees for performance of work under the provisions of this contract whose performance of work is satisfactory to the Officer in Charge. Should any employee's work performance become unsatisfactory to the Officer in Charge, the Officer in Charge shall forthwith notify OPERATOR in writing of his conclusion in this respect and OPERATOR will, within thirty (30) days thereafter, disassociate such employee from any task or function to be performed in connection with the performance of this contract.

(h) No OPERATOR employee shall seek or accept gifts, entertainment, or gratuity from any person or organization doing or seeking to do business with the UNIT or the NAVY.

(i) An OPERATOR employee who is on sick or accident leave for thirty (30) consecutive days or a cumulation of forty-five (45) days during any one calendar year commencing from the first day of his employment at the UNIT shall be transferred and replaced with no additional charges being made to the UNIT after transfer.

(j) Engineering functions will be provided by the OPERATOR, except in those instances in which NAVY elects to perform engineering with its own personnel. The costs of all engineering work charged to the UNIT shall be apportioned by the OPERATING COMMITTEE.

#### SECTION V. OPERATOR'S FEE.

(a) In addition to reimbursement for costs as hereinafter provided for in Section VI, OPERATOR shall receive monthly six thousand dollars (\$6,000.00) as a fee for the performance of all obligations and services rendered hereunder. In addition, the OPERATOR shall receive monthly four thousand dollars (\$4,000.00) as compensation for overhead expenses, not including salaries and expenses of the field superintendent. It is understood that the purpose of the overhead expense fee is to provide a fixed amount for this category of costs, regardless of the amount of the actual incurrence. In consideration therefor, no other overhead expenses, of any type whatsoever, regardless of the place of incurrence, shall be treated as an actual cost for purposes of reimbursement of costs.

(b) In the event that there is a material change of circumstances, economic or otherwise, under which this contract is performed, which change, in the opinion of the Secretary of the Navy, warrants a change in the fees from those specified in Section V(a) above, the Secretary of the Navy may, subject to mutual agreement with the OPERATOR, adjust the fees above specified to reflect such changes. Either NAVY or the OPERATOR may initiate action for such adjustment.

#### SECTION VI. COSTS OF EXPLORATION, PROSPECTING, DEVELOPMENT AND OPERATION.

(a) The costs of exploration, prospecting, development, and operation incurred by the OPERATOR pursuant to this contract, including the OPERATOR'S fee specified in Section V hereof, shall be apportioned initially between the UNIT and NAVY in the same proportions as the UNIT costs and NAVY'S non-UNIT costs bear to the total costs. The UNIT costs shall be charged to the accounts of NAVY and STANDARD upon the basis of actual

cost in accordance with the Accounting Procedure attached hereto as Schedule A and made a part hereof, and in accordance with such standards of completeness and accuracy as may be directed by the Officer in Charge.

(b) Prior to the actual performance of any item of work which has been authorized under Section IV(a) hereof, or the placing of any purchase order for, or the furnishing of, supplies, materials and equipment contemplated by this contract, which certain item or order does, or is likely to, involve a total cost in excess of twenty five hundred dollars (\$2,500), or such amount as the Officer in Charge may from time to time establish, OPERATOR shall, except in an emergency, submit to the OPERATING COMMITTEE a written estimate of the cost of such work or order and, before proceeding, secure the concurrence of the OPERATING COMMITTEE. If, in the opinion of the OPERATING COMMITTEE, the estimated cost is excessive and concurrence is withheld for that reason, the OPERATING COMMITTEE shall so notify OPERATOR within ten (10) days after receipt of such written estimate. The OPERATOR shall thereafter secure bids from three or more responsible and qualified independent contractors regularly engaged in such work. If any one of such bids is lower than the estimated cost originally submitted, the OPERATOR with the concurrence of the OPERATING COMMITTEE shall either (1) perform the work with its own personnel at the cost stated in the lowest bid, or (2) contract with the lowest bidder for the performance by the latter of such work. The Officer in Charge will be notified immediately of any emergency work undertaken without his approval.

(c) To the extent permitted by the Officer in Charge and the OPERATING COMMITTEE, a direct cost under this contract will be the salary and related expenses of employees of OPERATOR for a period preceding the effective date of this contract. These employees will participate in a joint inventory and become familiar with UNIT and RESERVE operations. This shall not entitle OPERATOR to any fee or overhead for this period.

#### SECTION VII. BILLING FOR COSTS OF EXPLORATION, PROSPECTING, DEVELOPMENT AND OPERATION.

(a) Liability as between NAVY and STANDARD for the fees and costs of exploring, prospecting, developing, and operating hereunder shall accrue, be determined, and be paid in the manner provided in the UNIT PLAN CONTRACT, the SOUTH FLANK WATER INJECTION AGREEMENT, or the WEST END WATER INJECTION AGREEMENT, as appropriate. Guidance in this matter will be found in the "Procedure Manual, Accounting for UO-NPR No. 1 Costs."

(b) OPERATOR shall submit monthly, as of the last day of each month, to the Officer in Charge, an invoice for an amount estimated to be NAVY'S and STANDARD'S shares of the fees and costs incurred in that month, which NAVY and STANDARD are required to pay currently under the UNIT PLAN CONTRACT, the SOUTH FLANK WATER INJECTION AGREEMENT and the WEST END WATER

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INJECTION AGREEMENT and such other agreements as NAVY and STANDARD may from time to time enter into. NAVY and STANDARD shall promptly remit to OPERATOR the amount of their respective shares of such estimate as a provisional payment. At the same time that OPERATOR submits the above-mentioned invoice, it shall also submit an invoice showing NAVY'S share and STANDARD'S share of the actual accrued costs and fees for the preceding month's operations. This invoice will reflect the amount of provisional payment, if any, for that month and will be supported by a statement of fees and costs incurred in that month. If NAVY'S and STANDARD'S shares of the fees and costs actually incurred, as shown by such statement and invoice, are greater than the estimated amount for said month paid by NAVY and STANDARD or either of them, pursuant to this paragraph, then the deficient party shall promptly pay to OPERATOR the difference in the amount specified in such statement and the amount paid pursuant to said estimate. If the share of either NAVY or STANDARD pertaining to the fees and costs actually incurred as shown by such statement and invoice is less than the amount paid by either pursuant to such estimate, such difference shall be deducted from the amount due OPERATOR from either according to the estimate for the following month. Estimates of costs, invoices, and statements shall be in such form and reasonable detail as NAVY may require. The invoices with statements of costs shall be certified by two officers of OPERATOR (or other responsible officials of OPERATOR acceptable to the Officer in Charge), one of whom shall be a person supervising accounting with respect to this Agreement. At any time or times prior to final payment on account of actual costs and fees, either NAVY or STANDARD shall be permitted to make such audit of invoices and statements of cost as it may deem proper. Each provisional payment shall be subject to reduction to the extent of the amounts included in the related invoices and statement of costs which are found not to constitute NAVY'S or STANDARD'S share of actual cost and shall also be subject to any reduction for overpayments or to any increase for underpayments on preceding invoices. On receipts of the final invoice and statement, NAVY and STANDARD shall pay any balance of its share of actual costs or fees.

(c) An invoice shall be submitted by OPERATOR to NAVY for any costs incurred by OPERATOR in performing operations on behalf of NAVY as contemplated in paragraph (d) of Section IV.

(d) In the event of any disallowance of costs in the audit of the monthly invoices and statements, and the books and records of the services performed hereunder, the Officer in Charge shall determine the allowability, of any and all such items of cost after he consults, as he deems necessary, with the OPERATING COMMITTEE with respect to the propriety and acceptability of any rates, wages, salaries, and rents involved. If the OPERATOR does not agree with such a determination, it may take appropriate action under the Disputes Clause, Section XX hereof.

SECTION VIII. NAVY MATERIALS, SERVICES, PERSONNEL, SUPPLIES AND EQUIPMENT.

(a) NAVY may at any time and at its election, furnish materials, services, personnel, supplies, and equipment suitable for or useful in the exploration, prospecting, development, and operation contemplated by this contract. Materials, supplies and equipment will be furnished to the UNIT at fair market value for any such materials as determined by the OPERATING COMMITTEE. Services, including such engineering services as performed or otherwise provided by NAVY, will be provided at actual cost to NAVY. For any such materials, services, personnel, supplies, and equipment used for the UNIT, STANDARD shall be charged on its account with its percentage share of the costs as determined by the OPERATING COMMITTEE.

(b) All equipment, machinery and other property, exclusive of consumable supplies and materials, which the UNIT acquires, shall be appropriately identified by marking or otherwise as the property of the UNIT. Appropriate inventory records for supplies, materials, equipment, machinery, and other properties shall be established and maintained currently by OPERATOR for the UNIT, the SOUTH FLANK WATER INJECTION AGREEMENT, and the WEST END WATER INJECTION AGREEMENT in a manner satisfactory to NAVY.

(c) OPERATOR shall have the right and it shall be the duty of OPERATOR, to dispose of scrap, salvage, materials and equipment acquired as a cost to the UNIT or under the SOUTH FLANK WATER INJECTION AGREEMENT or the WEST END WATER INJECTION AGREEMENT and which are determined by the Officer in Charge and the OPERATING COMMITTEE not to be needed or required for immediate or future operations under the UNIT PLAN CONTRACT, or the SOUTH FLANK WATER INJECTION AGREEMENT, or the WEST END WATER INJECTION AGREEMENT. Such dispositions by OPERATOR may be made by sale or transfer after such advertising as the Officer in Charge may direct and subject to review of such sale or transfer by the OPERATING COMMITTEE. Any payments received by OPERATOR shall be retained by OPERATOR, provided that proper credit therefor shall be allotted to NAVY and STANDARD on their accounts for monthly payment under Section VI(b) hereof.

(d) With the approval of the Officer in Charge after consultation with the OPERATING COMMITTEE, equipment, machinery and property of the UNIT may be rented or otherwise temporarily used by an authorized third party, or by NAVY or STANDARD for purposes other than operation of the UNIT. The OPERATING COMMITTEE shall fix the fair rental to be charged therefor

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which shall be properly reflected in the accounts of the UNIT; and any rental payments received in cash shall be retained by OPERATOR, provided that proper adjustments shall be made in the accounts of the UNIT.

SECTION IX. RECORDS AND REPORTS.

(a) OPERATOR shall keep and maintain on the RESERVE, or at such other places as shall be satisfactory to NAVY, and shall deliver to NAVY on request, the following records:

(1) Complete and accurate records of the quantities of oil, gas, natural gasoline, associated hydrocarbons and water resulting from production from the RESERVE, together with records of quantities of water, gas, and other substances injected, as appropriate;

(2) Complete and accurate records of OPERATOR'S cost of exploration, prospecting, development and operation hereunder, including all other data necessary or proper for the settlement of the accounts between NAVY and STANDARD under this contract;

(3) A separate set of accounts, books and records of the UNIT, as such, in a manner satisfactory to NAVY, including those costs which NAVY may incur, directly or through contracts with third parties, a record of which shall be furnished or caused to be furnished by NAVY; and likewise a separate set of accounts, books and records for the SOUTH FLANK WATER INJECTION AGREEMENT and WEST END WATER INJECTION AGREEMENT, or such other agreements as NAVY and STANDARD may from time to time enter into;

(4) Complete and accurate inventory records.

(b) OPERATOR shall furnish to NAVY and to each member of the OPERATING COMMITTEE, at the times hereinafter mentioned, the following:

(1) On or before the last day of each calendar month, a written statement, in such form as may be prescribed by the Officer in Charge, showing the quantities of production from the RESERVE, and the costs incurred during the preceding calendar month.

(2) Annually, by 1 March, an inventory of all facilities and equipment of the RESERVE.

(3) Upon request, such other information relating to all operations hereunder as the OPERATING COMMITTEE may require in the performance of its functions.

(c) All work, services performed, and materials furnished under this contract, including the wells, improvements, alterations, machinery, equipment, and fixtures, and all documentary records relative thereto and relative to surveys or investigations being made on the RESERVE, shall be subject at all reasonable times to inspection by the OPERATING COMMITTEE, the Officer in Charge or other representative of NAVY or accredited representative of STANDARD.

(d) Any of OPERATOR'S books and records, wherever relevant to the determination of the actual cost hereunder, shall be available, at any and all reasonable times, for inspection and examination by designated representatives of NAVY and STANDARD.

(e) OPERATOR shall preserve and maintain all records pertaining to this contract, the UNIT PLAN CONTRACT, former Operating Agreements (NOD-4220 and NOD-9535), the SOUTH FLANK WATER INJECTION AGREEMENT, and the WEST END WATER INJECTION AGREEMENT and, except upon written authority of the OPERATING COMMITTEE will not dispose of any UNIT records, and, except upon written authority of the Officer in Charge, will not dispose of any non-UNIT records. In the event of expiration or termination of this contract, or at such other times as NAVY may request, OPERATOR shall surrender all such records to NAVY. When computers are utilized in the production of any of the foregoing records, NAVY will be provided at the time of the surrender of the records with all input-output data and complete documented programs, including tapes and/or cards and other pertinent and associated data.

#### SECTION X. DILIGENCE.

(a) OPERATOR shall perform all operations under this contract with reasonable diligence, in a good and workmanlike manner, commensurate with practical and economical operations, and in accordance with sound oil field engineering, producing, and accounting practices.

(b) OPERATOR shall not be deemed to be in default under this agreement for:

- (1) Failing to perform any act hereunder which would be in violation of any order, rule, regulation or directive promulgated or issued by any regulatory body having jurisdiction, or performing any act contrary to the terms of this contract but required by any such order, rule, regulation, or directive; or
- (2) Failing to discharge, at the times contemplated in this contract, any of its obligations or undertakings hereunder by reason of the intervention of conditions or circumstances beyond its control.

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#### SECTION XI. INSURANCE.

(a) OPERATOR shall procure and thereafter maintain workmen's compensation, employer's liability, bodily injury liability insurance, and such other insurance with respect to work done by OPERATOR under this contract, as NAVY may from time to time require or approve. All of said insurance shall be in such form, in such amounts, for such periods of time, and with such insurers, as the NAVY may from time to time require or approve.

(b) OPERATOR, in lieu of procuring and maintaining insurance referred to in paragraph (a) above, may, subject to the approval of NAVY, be the insurer as to any or all of such insurable risks. In the event that OPERATOR itself assumes the insurance of such risks, then OPERATOR may include in actual costs an equitable portion of the charges set up for such purposes under a system of accounting regularly employed by OPERATOR, provided such system is in accordance with sound accounting practices, such charges to be at rates not exceeding the lawful or approved rates of insurance companies for such types of insurance less allowance for the acquisition cost incurred by such companies.

#### SECTION XII. EFFECTIVE DATE OF CONTRACT.

(a) This contract shall be subject to the written approval of the President of the United States, following consultation with the Committees on Armed Services of the House of Representatives and Senate of the Congress of the United States, and shall not be binding until so approved.

(b) The OPERATOR covenants to undertake the services hereby contracted for on or about 1 January 1972, as directed by NAVY.

#### SECTION XIII. TERM.

The term of this agreement shall commence on 1 January 1972, and run until midnight, Pacific Daylight Time, 30 June 1976, unless sooner terminated as provided herein.

#### SECTION XIV. TERMINATION.

Both NAVY and OPERATOR shall have the right at any time to give notice of intention to terminate this agreement. The agreement will then terminate nine months after such notice has been given as provided in Section XVI hereof.

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#### SECTION XV. EXTENSION.

After this Agreement has been in effect for three years, it may be extended by mutual consent of NAVY and OPERATOR for any period not to exceed five years beyond the normal expiration date hereof.

#### SECTION XVI. NOTICES.

Any notice required to be given by NAVY to OPERATOR shall be in writing and shall be delivered personally to an authorized representative of OPERATOR or forwarded by United States mail addressed to OPERATOR at 225 Bush Street, San Francisco, California 94120.

Any notice to be given by OPERATOR to NAVY shall be in writing and shall similarly be delivered or mailed to the Secretary of the Navy via the Officer in Charge, Naval Petroleum Reserves in California, P. O. Box 2610, Bakersfield, California 93303. Changes of their respective addresses may be made by either party on written notice to the other.

#### SECTION XVII. SUBCONTRACTS.

OPERATOR may, with the approval of the Officer in Charge, enter into subcontracts with third parties for the performance of particular portions of the exploration, prospecting, development and operation of the RESERVE contemplated by this contract.

#### SECTION XVIII. BOND.

(a) OPERATOR agrees to furnish, at its expense and not as a reimbursable cost item, prior to the execution of this agreement by NAVY, security for the faithful performance by OPERATOR of its obligations hereunder in the form of a corporate surety bond, acceptable to and approved by NAVY, in substantially the form of the performance bond set forth in Schedule C annexed, in the penal sum of \$500,000 conditioned upon OPERATOR'S compliance with the terms of this agreement. In the alternative and for the same purpose, OPERATOR may deposit with a national bank designated by NAVY, OPERATOR'S bond secured by Federal negotiable securities in the aggregate par value of \$500,000 with power of attorney in a form acceptable to NAVY.

(b) If the President of the United States does not approve this agreement the aforementioned security will be returned to OPERATOR.

(c) Upon request from OPERATOR, the Director, Naval Petroleum and Oil Shale Reserves, may reduce the amount of the performance bond or securities deposited whenever it is deemed that the amount is greater than necessary to afford adequate security hereunder. If at any time subsequent

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to any such reduction, the Secretary of the Navy should determine that the performance bond is too low to afford adequate security hereunder, he may require OPERATOR to increase the performance bond by an amount which he deems to be sufficient security. However, the performance bond shall never exceed \$500,000.

#### SECTION XIX. DEFAULT.

Upon failure of OPERATOR to perform any obligation under this contract, NAVY shall have the right to terminate this contract upon thirty (30) days written notice to OPERATOR specifying OPERATOR'S failure to perform, provided that OPERATOR does not within 30 days correct, or commence operations designed to correct such default. Upon termination by NAVY under this Section, OPERATOR shall at the option of NAVY be obligated under the contract to pay to NAVY the amount determined by the Director, Naval Petroleum and Oil Shale Reserves, as the damage, loss, or excess cost to NAVY on account of OPERATOR'S default. Any disagreement under this Section shall be treated as a dispute under Section XX. The rights and remedies provided in this Section shall be in addition to and not in lieu of any other rights and remedies provided by law or under this contract.

#### SECTION XX. DISPUTES.

(a) Except as otherwise specifically provided in this agreement, any dispute concerning a question of fact arising hereunder which is not disposed of by mutual understanding shall be decided by the Director, Naval Petroleum and Oil Shale Reserves, who shall reduce his decision to writing and mail (by registered mail, return receipt requested) or otherwise furnish a copy thereof to OPERATOR. Within thirty (30) days from the date of receipt of such decision, OPERATOR may appeal by mailing or otherwise furnishing to the Director, Naval Petroleum and Oil Shale Reserves, a written appeal addressed to the Secretary of the Navy, and the decision of the Secretary or his duly authorized representative for hearing such appeals shall be final and conclusive, unless determined by a court of competent jurisdiction to have been fraudulent or capricious or arbitrary or so grossly erroneous as necessarily to imply bad faith, or not supported by substantial evidence; provided that, if no such appeal is taken, the decision of the Director, Naval Petroleum and Oil Shale Reserves, shall be final and conclusive. In connection with any appeal proceeding under this clause, OPERATOR shall be afforded an opportunity to be heard and to offer evidence in support of its appeal. Pending final decision of a dispute hereunder, OPERATOR shall proceed diligently with the performance of the agreement and in accordance with the decision of the Director, Naval Petroleum and Oil Shale Reserves.

(b) This "Disputes" clause does not preclude consideration of questions of law in connection with decisions provided for in paragraph (a) above: Provided, that nothing in this agreement shall be construed as making final the decision of any administrative official, representative, or board on a question of law.

#### SECTION XXI. GENERAL PROVISIONS.

In addition to the foregoing this contract is governed by the covenants and requirements included herein and labeled "General Provisions".

##### (a) Assignment.

OPERATOR shall not make or attempt to make any assignment of this agreement or any interest therein.

##### (b) Patents.

OPERATOR shall hold and save NAVY, its officers, agents, servants, and employees, harmless from patent liability of any nature or kind, including costs and expenses, for or on account of, any patented or unpatented invention made or used in the performance of this agreement, including the use or disposal thereof by or on behalf of NAVY; provided, that the foregoing shall not apply to inventions covered by applications for United States Letters Patent which, on or after the date of execution of this agreement, are being maintained in secrecy under the provisions of Title 35, U.S.C. 181-188. Provided further, that this clause shall not apply as far as NAVY is concerned if the OPERATOR has acted in the instance of alleged patent infringement at the express direction of NAVY to the extent of NAVY specifying the use of the invention concerned.

##### (c) Convict Labor.

In connection with the performance of work under this contract, OPERATOR agrees not to employ any person undergoing sentence of imprisonment at hard labor.

##### (d) Nondiscrimination in Employment.

During the performance of this contract, ~~in connection with performance of work under this agreement~~, OPERATOR agrees as follows:

(1) OPERATOR will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The OPERATOR will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to

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their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. OPERATOR agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Officer in Charge setting forth the provisions of this nondiscrimination clause.

(2) OPERATOR will, in all solicitations or advertisements for employees placed by or on behalf of OPERATOR, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(3) OPERATOR will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract understanding, a notice, to be provided by the Officer in Charge, advising the labor union or workers' representative of the OPERATOR'S commitments under Section 202 of Executive Order No. 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) OPERATOR will comply with the provisions of Executive Order No. 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(5) OPERATOR will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the Director, Naval Petroleum and Oil Shale Reserves, and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of OPERATOR'S noncompliance with the non-discrimination clauses of this agreement or with any of such rules, regulations, or orders, this agreement may be cancelled, terminated, or suspended in whole or in part and OPERATOR may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(7) OPERATOR will include the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. OPERATOR will take such action with respect to any subcontract or purchase order as the Director, Naval Petroleum and Oil Shale Reserves, may direct as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event OPERATOR becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Director, OPERATOR may request the United States to enter into such litigation to protect the interests of the United States.

(e) Officials not to Benefit.

No member of or delegate to Congress, Resident Commissioner, or officer or employee of NAVY shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

(f) Covenant Against Contingent Fees.

OPERATOR warrants that no person or selling agency has been employed or retained to solicit or secure this agreement upon an understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by OPERATOR for the purpose of procuring business. For breach or violation of this warranty, NAVY shall have the right to annul this agreement without liability on the part of NAVY to OPERATOR, or in its discretion to recover from OPERATOR, in addition to the consideration herein set forth, the amount of such commission, brokerage, or contingent fee.

(g) Contract Work Hours Standards Act.

This contract, to the extent that it is of a character specified in the Contract Work Hours Standards Act (40 U.S.C. 327-330), is subject to the following provisions and to all other applicable provisions and exceptions of such Act and the regulations of the Secretary of Labor thereunder.

(1) Overtime requirements. Neither OPERATOR nor any subcontractor contracting for any part of the work hereunder which may require or involve the employment of laborers or mechanics shall require or permit any laborer or mechanic

in any workweek in which he is employed on such work to work in excess of forty (40) hours in such workweek or work subject to the provisions of the Contract Work Hours Standards Act unless such laborer or mechanic receives compensation at a rate not less than one and one-half times his basic rate of pay for all such hours worked in excess of eight hours in any calendar day or in excess of forty (40) hours in such workweek, whichever is the greater number of overtime hours.

(2) Violations; liability for unpaid wages, liquidated damages. In the event of any violation of the provisions of paragraph (1), the OPERATOR and any subcontractor responsible therefor shall be liable to any affected employee for his unpaid wages. In addition, OPERATOR and subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic employed in violation of the provisions of paragraph (1) in the sum of \$10 for each calendar day on which such employee was required or permitted to be employed on such work in excess of eight hours or in excess of his standard workweek of forty hours without payment of the overtime wages required by paragraph (1).

(3) Withholding for unpaid wages and liquidated damages. The Secretary may withhold from OPERATOR, from any moneys payable on account of work performed by OPERATOR or subcontractor, such sums as may administratively be determined to be necessary to satisfy any liabilities of OPERATOR or any subcontractor hereunder for unpaid wages and liquidated damages as provided in the provisions of paragraph (2).

(4) Subcontracts. OPERATOR shall insert paragraphs (1) through (4) of this clause in all subcontracts, and shall require their inclusion in all subcontracts of any tier.

(5) Records. OPERATOR shall maintain payroll records containing the information specified in 29 C.F.R. 516.2(a). Such records shall be preserved for three years from the completion of the contract.

(6) Copeland Regulations. OPERATOR shall comply with the Copeland Regulations of the Secretary of Labor (29 C.F.R., Part 3) which are incorporated herein by reference.

(h) Renegotiation.

(1) To the extent required by law, this contract is subject to the Renegotiation Act of 1951 (50 U.S.C. App. 1211,

et seq.), and to any subsequent act of Congress providing for the renegotiation of contracts. Nothing contained in this clause shall impose any renegotiation obligation with respect to this contract or any subcontract hereunder which is not imposed by an act of Congress heretofore or hereafter enacted. Subject to the foregoing this contract shall be deemed to contain all the provisions required by Section 104 of the Renegotiation Act of 1951, and by any such other act, without subsequent contract amendment specifically incorporating such provisions.

(2) The OPERATOR agrees to insert the provisions of this clause, including this paragraph (2), in all subcontracts, as that term is defined in Section 103g of the Renegotiation Act of 1951 or in any subsequent act of Congress providing for the renegotiation of contracts.

(i) Davis-Bacon Act.

Insofar as performance by OPERATOR or any subcontractor hereunder shall involve construction work, the provisions of the Davis-Bacon Act (40 U.S.C. 276a, 276(a)(7)) and regulations issued pursuant thereto shall apply.

(j) Buy American Act.

Insofar as performance hereunder by OPERATOR or any subcontractor shall involve procurement of manufactured articles, materials, and supplies, the provisions of 41 U.S.C. 10a - 10d shall apply.

IN WITNESS WHEREOF, the parties hereto have executed this agreement in quadruplicate as of the day and year first above written.

THE UNITED STATES OF AMERICA

By \_\_\_\_\_

Secretary of the Navy

John L. Devereux  
STANDARD OIL COMPANY OF CALIFORNIA  
OPERATOR

By \_\_\_\_\_

Title \_\_\_\_\_ President

By \_\_\_\_\_

Title \_\_\_\_\_ Assistant Secretary

(SEAL)

Attest:

H. L. Devereux  
Secretary

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CONTRACT NO. NOD-9930

CORPORATE AUTHORITY

I, H. L. Severance, certify that I am the  
Secretary of Standard Oil Company of  
California, named as OPERATOR herein; that H. J. Haynes  
and J. P. Bowman,  
who signed this contract on behalf of the corporation, were then  
President and Assistant Secretary  
of the corporation; that the contract was duly executed for and on  
behalf of the corporation by authority of its governing body and is  
within the scope of its corporate powers.

IN WITNESS WHEREOF, I have hereunto set my hand and the seal of  
the corporation on this 3rd day of November, 1971.

  
Secretary

(CORPORATE SEAL)

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# EXHIBIT 39

Downloaded from <http://www.everspec.com>  
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**METRIC**

MIL-DTL-83133J  
16 December 2015

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SUPERSEDING  
MIL-DTL-83133H  
w/ AMENDMENT 2  
24 December 2013

## **DETAIL SPECIFICATION**

### **TURBINE FUEL, AVIATION, KEROSENE TYPE, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37)**

This specification is approved for use by all Departments and Agencies of the Department of Defense.



Comments, suggestions, or questions on this document should be addressed to AFPET/PTPS, 2430 C Street, Building 70, Area B, Wright-Patterson AFB OH 45433-7631 or e-mailed to [AFPA.PTPS@us.af.mil](mailto:AFPA.PTPS@us.af.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

AMSC N/A

FSC 9130

**DISTRIBUTION STATEMENT A.** Approved for public release; distribution is unlimited.

## MIL-DTL-83133J

## 1. SCOPE

1.1 Scope. This specification covers three grades of kerosene type aviation turbine fuel, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37).

1.2 Classification. Aviation turbine fuel will be of the following grades, as specified (see [6.2](#)).

Grade	NATO Code No.	Description
JP-8	F-34	Kerosene type turbine fuel which will contain a static dissipater additive, corrosion inhibitor/lubricity improver, and fuel system icing inhibitor, and may contain antioxidant and metal deactivator.
---	F-35	Kerosene type turbine fuel which will contain a static dissipater additive, may contain antioxidant, corrosion inhibitor/lubricity improver, and metal deactivator but will not contain fuel system icing inhibitor.
JP-8+100	F-37	JP-8 type kerosene turbine fuel which contains thermal stability improver additive (NATO S-1749) as described in <a href="#">3.3.6</a> .

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections [3](#) and [4](#) of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections [3](#) and [4](#) of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

## DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-25017	- Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (NATO S-1747)
MIL-DTL-85470	- Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745

## DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-290	- Packaging and Marking of Petroleum and Related Products
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## QUALIFIED PRODUCTS LIST

QPL-25017	- Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (NATO S-1747)
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## MIL-DTL-83133J

(Copies of these documents are available online at <http://quicksearch.dla.mil>.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

## ASTM INTERNATIONAL

ASTM D56	- Standard Test Method for Flash Point by Tag Closed Cup Tester
ASTM D86	- Standard Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure
ASTM D93	- Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
ASTM D129	- Standard Test Method for Sulfur in Petroleum Products (General High Pressure Decomposition Device Method)
ASTM D130	- Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
ASTM D156	- Standard Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)
ASTM D381	- Standard Test Method for Gum Content in Fuels by Jet Evaporation
ASTM D445	- Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
ASTM D976	- Standard Test Method for Calculated Cetane Index of Distillate Fuels
ASTM D1094	- Standard Test Method for Water Reaction of Aviation Fuels
ASTM D1266	- Standard Test Method for Sulfur in Petroleum Products (Lamp Method)
ASTM D1298	- Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
ASTM D1319	- Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption
ASTM D1322	- Standard Test Method for Smoke Point of Kerosine and Aviation Turbine Fuel
ASTM D1840	- Standard Test Method for Naphthalene Hydrocarbons in Aviation Turbine Fuels by Ultraviolet Spectrophotometry
ASTM D2276	- Standard Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling
ASTM D2386	- Standard Test Method for Freezing Point of Aviation Fuels
ASTM D2425	- Standard Test Method for Hydrocarbon Types in Middle Distillates by Mass Spectrometry
ASTM D2622	- Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-Ray Fluorescence Spectrometry

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ASTM D2624	- Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels
ASTM D2887	- Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography
ASTM D3120	- Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry
ASTM D3227	- Standard Test Method for (Thiol Mercaptan) Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels (Potentiometric Method)
ASTM D3241	- Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels
ASTM D3242	- Standard Test Method for Acidity in Aviation Turbine Fuel
ASTM D3338	- Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D3343	- Standard Test Method for Estimation of Hydrogen Content of Aviation Fuels
ASTM D3701	- Standard Test Method for Hydrogen Content of Aviation Turbine Fuels by Low Resolution Nuclear Magnetic Resonance Spectrometry
ASTM D3828	- Standard Test Methods for Flash Point by Small Scale Closed Cup Tester
ASTM D3948	- Standard Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer
ASTM D4052	- Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
ASTM D4057	- Standard Practice for Manual Sampling of Petroleum and Petroleum Products
ASTM D4177	- Standard Practice for Automatic Sampling of Petroleum and Petroleum Products
ASTM D4294	- Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectrometry
ASTM D4306	- Standard Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination
ASTM D4529	- Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D4629	- Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection
ASTM D4737	- Standard Test Method for Calculated Cetane Index by Four Variable Equation

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ASTM D4809	- Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)
ASTM D4952	- Standard Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents (Doctor Test)
ASTM D5006	- Standard Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels
ASTM D5291	- Standard Test Method for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants
ASTM D5452	- Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
ASTM D5453	- Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
ASTM D5972	- Standard Test Method for Freezing Point of Aviation Fuels (Automatic Phase Transition Method)
ASTM D6045	- Standard Test Method for Color of Petroleum Products by the Automatic Tristimulus Method
ASTM D6304	- Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration
ASTM D6751	- Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels
ASTM D6890	- Standard Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber
ASTM D7042	- Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)
ASTM D7111	- Standard Test Method for Determination of Trace Elements in Middle Distillate Fuels by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)
ASTM D7153	- Standard Test Method for Freezing Point of Aviation Fuels (Automatic Laser Method)
ASTM D7154	- Standard Test Method for Freezing Point of Aviation Fuels (Automatic Fiber Optical Method)
ASTM D7170	- Standard Test Method for Determination of Derived Cetane Number (DCN) of Diesel Fuel Oils—Fixed Range Injection Period, Constant Volume Combustion Chamber Method
ASTM D7171	- Standard Test Method for Hydrogen Content of Middle Distillate Petroleum Products by Low-Resolution Nuclear Magnetic Resonance Spectroscopy
ASTM D7224	- Standard Test Method for Determining Water Separation Characteristics of Kerosine-Type Aviation Turbine Fuels Containing Additives by Portable Separometer

## MIL-DTL-83133J

ASTM D7345	- Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure (Micro Distillation Method)
ASTM D7359	- Standard Test Method for Total Fluorine, Chlorine and Sulfur in Aromatic Hydrocarbons and Their Mixtures by Oxidative Pyrohydrolytic Combustion followed by Ion Chromatography Detection (Combustion Ion Chromatography-CIC)
ASTM D7619	- Standard Test Method for Sizing and Counting Particles in Light and Middle Distillate Fuels, by Automatic Particle Counter
ASTM D7777	- Standard Test Method for Density, Relative Density, or API Gravity of Liquid Petroleum by Portable Digital Density Meter
ASTM D7797	- Standard Test Method for Determination of the Fatty Acid Methyl Esters Content of Aviation Turbine Fuel Using Flow Analysis by Fourier Transform Infrared Spectroscopy – Rapid Screening Method
ASTM E29	- Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

(Copies of these documents are available from <http://www.astm.org>.)

## UOP, LLC

UOP 389	- Trace Metals in Organics by Wet Ashing - ICP-OES
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(Copies of this document are available from <http://www.astm.org>.)

## ENERGY INSTITUTE

IP 170	- Determination of flash point -- Abel closed-cup method
IP 540	- Determination of the existent gum content of aviation turbine fuel - Jet evaporation method
IP 564	- Determination of the level of cleanliness of aviation turbine fuel - Laboratory automatic particle counter method
IP 565	- Determination of the level of cleanliness of aviation turbine fuel - Portable automatic particle counter method
IP 577	- Determination of the level of cleanliness of aviation turbine fuel - Automatic particle counter method using light extinction
IP 583	- Determination of the fatty acid methyl esters content of aviation turbine fuel using flow analysis by Fourier transform infrared spectroscopy - Rapid screening method
IP 585	- Determination of fatty acid methyl esters (FAME), derived from bio-diesel fuel, in aviation turbine fuel - GC-MS with selective ion monitoring/scan detection method

## MIL-DTL-83133J

IP 590	- Determination of fatty acid methyl esters (FAME) in aviation turbine fuel - HPLC evaporative light scattering detector method
IP 599	- Determination of Fatty Acid Methyl Esters (FAME) in aviation turbine fuel - Gas Chromatography using heart-cut and refocusing

(Copies of these documents are available from <http://www.energyinstpubs.org.uk.>)

## EUROPEAN COMMITTEE FOR STANDARDIZATION

EN 14214	- Liquid petroleum products - Fatty acid methyl esters (FAME) for use in diesel engines and heating applications - Requirements and test methods
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(Copies of this document are available from <http://www.cen.eu.>)

## INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 4406	- Hydraulic fluid power - Fluids - Method for coding the level of contamination by solid particles
ISO 11171	- Hydraulic fluid power - Calibration of automatic particle counters for liquids

(Copies of these documents are available from <http://www.iso.org.>)

**2.4 Order of precedence.** Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

**3.1 Materials.** Unless otherwise specified (see [3.1.1](#)), fuel supplied under this specification shall be refined hydrocarbon distillate fuel oil containing additives in accordance with [3.3](#). The feedstock from which the fuel is refined shall be crude oils derived from petroleum, oil sands, oil shale, or mixtures thereof.

**3.1.1 Synthesized Materials.** With the approval of both the procuring activity and the applicable fuel technical authorities listed below, up to a total 50 volume percent of the finished fuel may consist of Synthesized Paraffinic Kerosene (SPK) derived from a Fischer-Tropsch (FT) process meeting the requirements of Appendix A (see [A.2](#)) or SPKs derived from Hydroprocessed Esters and Fatty Acids (HEFA) meeting the requirements of Appendix B (see [B.2](#)). HEFA-SPK has also been called Hydroprocessed Renewable Jet or Hydrotreated Renewable Jet (HRJ) and, for the purpose of this specification, the terms are considered interchangeable. Finished fuel containing FT-SPK or HEFA-SPK shall contain additives in accordance with [3.3](#). Finished fuel containing FT-SPK shall conform to the properties of [Table A-II](#) in addition to those of [Table I](#). Finished fuel containing HEFA-SPK shall conform to the properties of [Table B-II](#) in addition to those of [Table I](#). During the platform certification/approval process, permission from both procuring activity and the applicable fuel technical authority listed below shall be obtained prior to the use of a finished fuel containing SPK. All US Navy and US Air Force aircraft are certified for the use of fuel containing FT-SPK and HEFA-SPK. All tactical/combat equipment/vehicles in the US Army Ground fleet are approved to use fuel containing FT-SPK and HEFA-SPK. Platform certification/approval process is still on-going for US Army Aviation; therefore,

## MIL-DTL-83133J

permission from both procuring activity and the applicable cognizant activity listed below shall be obtained prior to the use of a finished fuel containing SPK.

Cognizant activity for the US Army Aviation: US Army RDECOM, Attn: RDMR-AEP, Building 4488, Room C-211, Redstone Arsenal, AL 35898-5000.

Procuring Activity: Product Technology & Standardization, DLA Energy, Rm 2843, 8725 John J. Kingman Road, Fort Belvoir, VA 22060.

**3.2 Chemical and physical requirements.** Unless otherwise specified (see [3.1.1](#)), the chemical and physical properties of the fuel shall be in accordance with those listed in [Table I](#).

**3.3 Additives.** The type and amount of each additive used shall be made available when requested by procuring activity or user (see [6.2.d](#)). The only additives approved for use are those referenced in this specification.

**3.3.1 Antioxidants.** Immediately after processing and before the fuel is exposed to the atmosphere (such as during rundown into feed/batch tankage), add an approved antioxidant formulation ([3.3.1.1](#)) or combination of approved antioxidant formulations in order to prevent the formation of gums and peroxides after manufacture. The concentration of antioxidant to be added shall be:

a. Not less than 17.2 milligrams (mg) nor more than 24.0 mg of active ingredient per liter (L) of fuel (6.0 to 8.4 lb/1000 barrels) to all JP-8 fuel that contains blending stocks that have been hydrogen treated or SPK derived from hydrotreated, hydrocracked, or hydroisomerized products of a Fischer-Tropsch or HEFA process.

b. At the option of the supplier, not more than 24.0 mg of active ingredient per liter of fuel (8.4 lb/1000 barrels) may be added to JP-8 fuels that do not contain hydrogen treated blending stocks or SPK derived from hydrotreated, hydrocracked, or hydroisomerized products of a Fischer-Tropsch or HEFA process.

**3.3.1.1 Antioxidant formulations.** The following antioxidant formulations are approved:

- a. 2,6-di-tert-butyl-4-methylphenol
- b. 6-tert-butyl-2,4-dimethylphenol
- c. 2,6-di-tert-butylphenol
- d. 75 percent min-2,6-di-tert-butylphenol  
25 percent max tert-butylphenols and tri-tert-butylphenols
- e. 72 percent min 6-tert-butyl-2,4-dimethylphenol  
28 percent max tert-butyl-methylphenols and tert-butyl-dimethylphenols
- f. 55 percent min 2,4-dimethyl-6-tert-butylphenol and  
15 percent min 2,6-di-tert-butyl-4-methylphenol and  
30 percent max mixed methyl and dimethyl tert-butylphenols

**3.3.2 Metal deactivator.** Metal deactivator additive, N,N'-disalicylidene-1,2-propanediamine, shall not be used in JP-8 unless the supplier has obtained written consent from the procuring activity and user. The concentration of active material used on initial batching of the fuel at the refinery shall not exceed 2.0 mg/L. Cumulative addition of metal deactivator when re-doping the fuel shall not exceed 5.7 mg/L.

**3.3.3 Static dissipater additive.** An additive shall be blended into the fuel in sufficient concentration to increase the conductivity of the fuel to within the range specified in [Table I](#) at the point of injection. The point of injection of the additive shall be determined by agreement between the purchasing

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authority and the supplier. The following electrical conductivity additive is approved: Stadis® 450 marketed by Innospec Fuel Specialties, LLC.

3.3.4 Corrosion inhibitor/lubricity improver additive. A corrosion inhibitor/lubricity improver (CI/LI) additive meeting MIL-PRF-25017 and listed in Qualified Products List (QPL)-25017 shall be blended into the JP-8 (NATO F-34) grade fuel by the contractor. The CI/LI additive is optional for NATO F-35, unless stated in the contract. The amount added shall be equal to or greater than the minimum effective concentration and shall not exceed the maximum allowable concentration listed in QPL-25017. The contractor or transporting agency, or both, shall maintain and upon request shall make available to the Government evidence that the CI/LI additives used are equal in every respect to the qualification products listed in QPL-25017. The point of injection of the CI/LI additive shall be determined by agreement between the purchasing authority and the supplier.

**TABLE I. Chemical and physical requirements and test methods.**

Property	Min	Max	ASTM or IP Test Method
<b>COMPOSITION</b>			
Color, Saybolt <sup>1</sup>			D156 <sup>2</sup> or D6045
Total acid number, mg KOH/g		0.015	D3242
Aromatics, vol percent		25.0	D1319
Sulfur, total, mass percent		0.30	D129, D1266, D2622, D3120 <sup>3</sup> , D4294 <sup>2</sup> , or D5453
Sulfur, mercaptan, mass percent or Doctor test <sup>4</sup>		0.002 negative	D3227 <sup>2</sup> D4952
<b>VOLATILITY</b>			
Distillation temperature, °C <sup>5</sup>			D86 <sup>2,6</sup> , D2887, or D7345 <sup>7</sup>
Initial boiling point <sup>1</sup>			
10 percent recovered		205	
20 percent recovered <sup>1</sup>			
50 percent recovered <sup>1</sup>			
90 percent recovered <sup>1</sup>			
Final boiling point		300	
Residue, vol percent		1.5	
Loss, vol percent		1.5	
Flash point, °C <sup>8</sup>	38		D56, D93 <sup>2</sup> , D3828, or IP 170
<b>DENSITY</b>			
Density, kg/L at 15 °C or Gravity, API at 60 °F	0.775 37.0	0.840 51.0	D1298, D4052 <sup>2</sup> , or D7777
<b>FLUIDITY</b>			
Freezing point, °C		-47	D2386 <sup>2</sup> , D5972, D7153, or D7154
Viscosity, at -20 °C, mm <sup>2</sup> /s		8.0	D445 <sup>2</sup> or D7042 <sup>9</sup>

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**TABLE I. Chemical and physical requirements and test methods – Continued.**

<b>Property</b>	<b>Min</b>	<b>Max</b>	<b>Test Method</b>
<b>COMBUSTION</b>			
Net heat of combustion, MJ/kg	42.8		D3338, D4529, or D4809 <sup>2</sup>
Hydrogen content, mass percent	13.4		D3343, D3701, D5291, or D7171 <sup>2</sup>
Smoke point, mm or Smoke point, mm, and Naphthalenes, vol percent	25.0  19.0	3.0	D1322  D1322 D1840
Calculated cetane index <sup>1</sup>			D976 or D4737
<b>CORROSION</b>			
Copper strip corrosion, 2 hr at 100 °C (212 °F)		No. 1	D130
<b>THERMAL STABILITY</b>			
Thermal stability (2.5 hr at 260 °C) <sup>10</sup> Change in pressure drop, mm Hg Tube rating: One of the following requirements shall be met: (1) Annex A1 VTR or (2) Annex A3 ETR or Annex A2 ITR, average deposit thickness, nm, over area of 2.5 mm <sup>2</sup>		25  <3 <sup>11</sup>  85	D3241
<b>ADDITIVES</b>			
Fuel system icing inhibitor, vol percent	0.07	0.10	D5006
Fuel electrical conductivity, pS/m <sup>12</sup>			D2624
<b>CONTAMINANTS</b>			
Existent gum, mg/100 mL <sup>13</sup>		7	D381 <sup>2</sup> or IP 540
Water reaction interface rating		1b	D1094
Microseparometer Rating <sup>14</sup>			D3948 or D7224 <sup>2</sup>
<b>NOTES:</b>			
1. To be reported – not limited. 2. Referee Test Method. 3. The sulfur content detection range for ASTM D3120 is 3.0 to 1000 mg/kg. 4. If the Doctor Test results in a failure ('positive' result), then mercaptan sulfur content shall be determined by the referee test method ASTM D3227. 5. Distillation property criteria are specified in ASTM D86 scale units. ASTM D2887 results shall be converted to estimated D86 results by application of the correlation in Appendix X4 "Correlation for Jet and Diesel Fuel (Procedures A and B)" of D2887 for comparison with the specified property criteria. Distillation residue and loss limits provide control of the distillation process during the D86 test method and do not apply to D2887. 6. ASTM D86 distillation is run at Group 4 conditions except that Group 3 condenser temperatures are used. 7. ASTM D7345 results shall be corrected to bias-free distillation results by the application of the correction factors in the D7345 Precision and Bias section.			

**TABLE I. Chemical and physical requirements and test methods – Continued.****NOTES:**

8. ASTM D56 may give results up to 1 °C (2 °F) below the ASTM D93 results. ASTM D3828 may give results up to 1.7 °C (3 °F) below the ASTM D93 results. Method IP 170 is also permitted, may give results up to 2.2 °C (4 °F) below the ASTM D93 results.
9. ASTM D7042 results shall be corrected to bias-free viscosity results by the application of the correction factor in the D7042 Precision and Bias section.
10. See [4.5.3](#). ASTM D3241 Annex A3 Ellipsometric Tube Rater (ETR) is the referee thermal stability method, when available; otherwise, Annex A2 Interferometric Tube Rater (ITR), when available. Tube deposit failures by ETR or ITR shall be reported as ">85 nm." If the ITR reports "N/A" for the tube's volume thickness, the result constitutes a failure and the result shall be reported as ">85 nm." If test results by either ETR or ITR are reported, then results by D3241 Annex A1 Visual Tube Rater (VTR) are not required.
11. Peacock or Abnormal color deposits result in a failure.
12. The conductivity must be between 150 and 600 pS/m for JP-8 (NATO [F-34](#)) and between 50 and 600 pS/m for NATO [F-35](#), at ambient temperature or 29.4 °C (85 °F), whichever is lower, unless otherwise directed by the procuring activity. In the case of JP-8+100 (NATO [F-37](#)), JP-8 with the thermal stability improver additive (see [3.3.6](#)), the conductivity limit must be between 150 to 700 pS/m at ambient temperature or 29.4 °C (85 °F), whichever is lower, unless otherwise directed by the procuring activity.
13. The preferred vaporizing medium for aviation turbine fuel is steam; however, the existent gum test IP 540 may be performed using air as the vaporizing medium. If air is used instead of steam, it shall be recorded. Test Method ASTM D381, using steam jet operating conditions, shall be the referee test method.
14. The minimum microseparometer rating at point of manufacture using a Micro-Separometer (MSEP) shall be as follows:

<b>JP-8 Additives</b>	<b>MSEP Rating, min.</b>
Antioxidant (AO)*, Metal Deactivator (MDA)*	90
AO*, MDA*, and Fuel System Icing Inhibitor (FSII)	85
AO*, MDA*, and Corrosion Inhibitor/Lubricity Improver (CI/LI)	80
AO*, MDA*, FSII, and CI/LI	70

\*Even though the presence or absence does not change these limits, samples submitted for specification or conformance testing shall contain the same additives present in the refinery batch. Regardless of which minimum the refiner selects to meet, the refiner shall report the MSEP rating on a laboratory hand blend of the fuel with all additives required by the specification.

**3.3.5 Fuel system icing inhibitor.** The use of a fuel system icing inhibitor shall be mandatory for JP-8 and shall be in accordance with MIL-DTL-85470. The point of injection of the additive for JP-8 shall be determined by agreement between the purchasing authority and the supplier. The fuel system icing inhibitor is not to be added to NATO [F-35](#) unless so directed by the purchasing authority.

**3.3.6 Thermal stability improver additive.** Due to logistic concerns, personnel at the operating location shall request written approval from the cognizant activity to add a thermal stability improver additive to the fuel. If approval is given, the concentration of the additive and location of injection shall be specified by the cognizant service activity listed below. For USAF aircraft, this approval does not override the single manager's authority for specifying allowed/disallowed fuels. JP-8 fuel with an approved thermal stability improver additive at the required concentration shall be designated as JP-8+100

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(NATO [F-37](#)). Thermal stability improver additive shall not be used in JP-8 without approval, in writing, from:

Cognizant activity for the US Navy and US Marine Corps: Naval Fuels and Lubricants Cross Functional Team, AIR-4.4.5, Building 2360, 22229 Elmer Road, Patuxent River, MD 20670-1534.

Cognizant activity for the US Air Force: Air Force Petroleum Office, AFPET/PTP, 2430 C Street, Building 70, Area B, Wright-Patterson AFB 45433-7631.

Cognizant activities for the US Army:

- a. US Army Ground: Fuels and Lubricants Technology Team, RDECOM-TARDEC, RDTA-SIE-ES-FPT-FLT, Building 210, 6501 E. 11 Mile Road, Warren, MI 48397-5000.
- b. US Army Aviation: US Army RDECOM, Attn: RDMR-AEP, Building 4488, Room C-211, Redstone Arsenal, AL 35898-5000.

3.3.6.1 Qualified additives. Qualified thermal stability improver additives are listed in [Table II](#).

**TABLE II. Qualified thermal stability improver additives.**

Additive Name	Qualification Reference	Manufacturer	Manufacturer Recommended Dosage Rate
SPEC AID 8Q462	AFRL/PRSF Ltr, 9 Dec 1997	GE Water & Process Technologies 9669 Grogan Mill Road The Woodlands, TX 77380	256 mg/L
SPEC AID 8Q462W	ASC/ENFA Tech Eval, 12 Apr 2011	GE Water & Process Technologies 9669 Grogan Mill Road The Woodlands, TX 77380	256 mg/L
AeroShell Performance Additive 101	AFRL/PRSF Ltr, 13 Jan 1998	Shell Aviation Limited Shell Centre York Road London, UK SE1 7NA	256 mg/L
BASF Kerojet™ 100	AFRL/RQTF Ltr, 25 Oct 2013	BASF Corporation 100 Park Avenue Florham Park, NJ 07932	256 mg/L
BASF Kerojet™ 100W	AFLCMC/EZFA Tech Eval 29 Sep 2015	BASF Corporation 100 Park Avenue Florham Park, NJ 07932	294 mg/L

3.3.7 Premixing of additives. Additives shall not be premixed with other additives before injection into the fuel so as to prevent possible reactions among the concentrated forms of different additives.

3.4 Workmanship. At the time of Government acceptance, the finished fuel shall be visually free from undissolved water, sediment, or suspended matter and shall be clear and bright. In case of dispute, the fuel shall be clear and bright at 21 °C (70 °F) and shall contain no more than 1.0 mg/L of particulate matter as required in [Table III](#).

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**3.5 Incidental contaminants.** At the time of Government acceptance, the concentration of incidental contaminants in the finished fuel shall not exceed the limits in [Table III](#). For a definition of incidental contaminants, see [6.4.8](#).

**TABLE III. Incidental Contaminants.**

<b>Material</b>	<b>Limits</b>		<b>ASTM or IP Test Method</b>
		<b>Max</b>	
Particulate matter (gravimetric), mg/L <sup>1</sup>		1.0	D2276 or D5452 <sup>2</sup>
Filtration time, minutes <sup>1</sup>		15	
Particle counting, individual channel counts & ISO Code <sup>3</sup>	Channel Counts	ISO Code <sup>4</sup>	IP 564, IP 565, IP 577, or D7619 <sup>2</sup>
≥ 4 µm (c) <sup>5</sup>	<sup>6</sup>	19	
≥ 6 µm (c) <sup>5</sup>	<sup>6</sup>	17	
≥ 14 µm (c) <sup>5</sup>	<sup>6</sup>	14	
≥ 30 µm (c) <sup>5</sup>	<sup>6</sup>	13	
Fatty Acid Methyl Ester (FAME) <sup>7</sup> , mg/kg		50	D7797, IP 583, IP 585 <sup>2</sup> , IP 590, or IP 599

**NOTES:**

1. A minimum sample size of 3.785 liters (1 gallon) shall be filtered. Filtration time will be determined in accordance with procedure in [Appendix C](#). This procedure may also be used for the determination of particulate matter as an alternate to ASTM D2276 or ASTM D5452.
2. Referee Test Method.
3. Alternate to the gravimetric particulate matter test method where equipment and laboratory capability exist. Should particulate counting result in failure, gravimetric particulate matter shall be the referee.
4. Per Table 1 "Allocation of scale numbers" of ISO 4406.
5. (c) indicates that the equipment has been calibrated in accordance with ISO 11171.
6. To be reported – not limited.
7. FAME meeting the requirements of ASTM D6751 or EN 14214. For a definition of FAME, see [6.4.9](#).

**3.6 Recycled, recovered, environmentally preferable, or biobased materials.** Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

**4. VERIFICATION**

**4.1 Classification of inspections.** The inspection requirements specified herein are classified as quality conformance inspections (see [4.2](#)).

**4.2 Qualification inspection conditions.** Test for acceptance of individual lots shall consist of tests for all requirements specified in section [3](#). Quality conformance inspection shall include the test requirement herein.

**4.2.1 Inspection lot.** For acceptance purposes, individual lots shall be examined as specified herein and subjected to tests for all requirements cited in section [3](#).

**4.3 Inspection.****4.3.1 Inspection conditions.**

**4.3.1.1 Refined hydrocarbon material.** Fuel supplied from traditionally refined hydrocarbon distillate fuel oil meeting requirements of [3.1](#) shall comply with the specified limiting values in [Table I](#) using the cited test methods. The specified limiting values must not be changed. This precludes any

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allowance for test method precision and adding or subtracting digits. For the purposes of determining conformance with the specified limiting values, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right hand place of digits used in expressing the specified limiting value, in accordance with the Rounding Method of ASTM E29.

4.3.1.2 Synthesized hydrocarbon material. Fuel supplied containing synthesized materials meeting requirements of Table A-I or Table B-I as stipulated in 3.1.1 shall comply with the specified limiting values in Table I and Table A-II or Table B-II, respectively, using the cited test methods. The specified limiting values must not be changed. This precludes any allowance for test method precision and adding or subtracting digits. For the purposes of determining conformance with the specified limiting values, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right hand place of digits used in expressing the specified limiting value, in accordance with the Rounding Method of ASTM E29.

#### 4.4 Sampling plans.

4.4.1 Sampling. Each bulk or packaged lot of material shall be sampled for verification of product quality in accordance with ASTM D4057 or ASTM D4177, except where individual test procedures contain specific sampling instructions.

4.4.1.1 A number of jet fuel properties are very sensitive to trace contamination which can originate from sample containers. For recommended sample containers refer to ASTM D4306.

4.4.2 Sampling for inspection of filled containers. A random sample of filled containers shall be selected from each lot and shall be subjected to the examination of filled containers as specified in 4.5.1.3.

#### 4.5 Methods of inspection.

##### 4.5.1 Examination of product.

4.5.1.1 Visual inspection. Samples selected in accordance with 4.4.1 shall be visually examined for compliance with 3.4.

4.5.1.2 Examination of empty containers. Before filled, each unit container shall be visually inspected for cleanliness and suitability in accordance with ASTM D4057.

4.5.1.3 Examination of filled containers. Samples taken as specified in 4.4.2 shall be examined for conformance to MIL-STD-290 with regard to fill, closure, sealing, leakage, packaging, packing, and markings. Any container with one or more defects under the required fill shall be rejected.

##### 4.5.2 Chemical and physical tests.

a. Tests to determine conformance to chemical and physical requirements of fuel supplied from traditionally refined hydrocarbon distillate fuel oil meeting requirements of 3.1 shall be conducted in accordance with Table I. The finished fuel shall pass all tests listed in Table I. No additional testing shall be required. Requirements contained herein are not subject to corrections for test tolerances. If multiple determinations are made, results falling within any specified repeatability and reproducibility tolerances may be averaged. For rounding of significant figures, ASTM E29 shall apply to all tests required by this specification.

b. Tests to determine conformance to chemical and physical requirements of fuel supplied containing synthesized materials meeting requirements of Table A-I or Table B-I as stipulated in 3.1.1 shall be conducted in accordance with Table I and Table A-II or Table B-II, respectively. The finished fuel shall pass all tests listed in Table I and Table A-II or Table B-II, respectively. No additional testing shall be required. Requirements contained herein are not subject to corrections for test tolerances. If multiple determinations are made, results falling within any specified repeatability and reproducibility tolerances may be averaged. For rounding of significant figures, ASTM E29 shall apply to all tests required by this specification.

4.5.3 Thermal stability tests. The thermal stability test shall be conducted using ASTM D3241 at a temperature of 260 °C (325 °C for FT-SPK (Appendix A) and HEFA-SPK (Appendix B)). Tube deposit ratings shall be measured using an Ellipsometric Tube Rater (D3241 Annex A3 ETR), when available; an

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Interferometric Tube Rater (D3241 Annex A2 ITR), when available; otherwise, a Visual Tube Rater (D3241 Annex A1 VTR). If test results by either ETR or ITR are reported, then results by the VTR are not required.

4.5.3.1 ASTM D3241 reported data. The following data shall be reported:

- a. Differential pressure in millimeter of mercury (mm Hg) at 150 minutes, or time to differential pressure of 25 mm Hg, whichever comes first.
- b. At the end of the test, the average deposit thickness in nanometers (nm) over an area of 2.5 mm<sup>2</sup> as determined with either the ETR or ITR, or the heater tube deposit rating as determined with the VTR.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see [6.2](#)). When actual packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The fuels covered by this specification are intended for use in aircraft turbine engines. JP-8 contains military unique additives that are required by military weapon systems. This requirement is unique to military aircraft and engine designs. When authorized, JP-8 (NATO [F-34](#)) may be used in ground-based turbine and diesel engines. NATO [F-35](#) is intended for commercial aviation, but can be converted to JP-8 ([F-34](#)) by the addition of the appropriate additives.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, date of this specification, and grade (type) of fuel.
- b. Quantity required and size containers desired.
- c. Level of packaging and packing required (see [5.1](#)).
- d. Location and injection method for addition of electrical conductivity additive, fuel system icing inhibitor and corrosion inhibitor/lubricity improver, as required.

6.3 Conversion of metric units. Units of measure have been converted to the International System of Units (SI) (Metric) in accordance with ASTM SI10. If test results are obtained in units other than metric or there is a requirement to report dual units, ASTM SI10, should be used to convert the units.

## 6.4 Definitions.

6.4.1 Bulk lot. A bulk lot consists of an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single isolated container or manufactured in a single plant run through the same processing equipment, with no change in ingredient material.

6.4.2 Packaged lot. A packaged lot consists of an indefinite number of 208-liter (55-gallon) drums, or smaller unit packages of identical size and type, offered for acceptance and filled from an isolated tank containing a homogeneous mixture of material; or filled with a homogeneous mixture of material run through the same processing equipment with no change in ingredient material.

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**6.4.3 Homogenous product.** A homogeneous product is defined as a product where samples taken at various levels of the batch tank are tested for the defining homogeneous characteristics and all values obtained meet the repeatability precision requirements for that test method.

**6.4.4 Synthesized Paraffinic Kerosene (SPK).** Kerosene consisting of n-paraffins, iso-paraffins and cycloparaffins.

**6.4.5 Fischer-Tropsch (FT) Process.** A catalyzed chemical process in which carbon monoxide and hydrogen are converted into liquid hydrocarbons of various forms. Typical catalysts used are based on iron and cobalt.

**6.4.6 Hydroprocessed Esters and Fatty Acids (HEFA) SPKs.** Synthetic Paraffinic Kerosene produced by hydroprocessing plant, algal oils or animal fats.

**6.4.7 Hydroprocessed or Hydrotreated Renewable Jet (HRJ).** Terminology used to identify HEFA SPKs.

**6.4.8 Incidental contaminants:** These are known contaminants that can be picked up during fuel conveyance. These have defined upper allowable limits but are not identified as fuel additives. Examples include sediment (particulate) and FAME (biodiesel).

**6.4.9 Fatty Acid Methyl Ester (FAME):** FAME is synonymous with biodiesel meeting the requirements of ASTM D6751 or EN 14214. Per ASTM D6751, "biodiesel is a fuel comprised of fatty acids derived from vegetable oils or animal fats, designated B100." JP-8 can pick up trace amounts of FAME when transported through conveyance methods, such as fungible product pipelines, where diesel fuel containing biodiesel is also transported.

#### **6.5 Subject term (key word) listing.**

- Antioxidants
- Biodiesel
- Corrosion inhibitor
- Fatty Acid Methyl Ester (FAME)
- Fischer-Tropsch
- Flash point
- Freezing point
- Hydrocarbon distillate fuel
- Hydrogen content
- Hydroprocessed Esters and Fatty Acids (HEFA)
- Hydroprocessed / Hydrotreated Renewable Jet (HRJ)
- Icing inhibitor
- Lubricity improver
- Static dissipater
- Synthesized Paraffinic Kerosene (SPK)
- Thermal stability improver

**6.6 International agreements.** Certain provisions of this specification are the subject of international standardization agreements NATO STANAG 1135 "Interchangeability of Fuels, Lubricants and Associated Products Used by the Armed Forces of the North Atlantic Treaty Nations," NATO AFLP 3747 "Guide Specifications (Minimum Quality Standards) for Aviation Turbine Fuels (F-24, F-27, F-34, F-35, F-37, F-40 and F-44)," and ASIC AIR STD FG 4024 "Interchangeability Chart of Standardised Aviation Fuels, Lubricants, and Associated Products." When amendment, revision, or cancellation of this specification is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels including departmental standardization offices, to change the agreement or make other appropriate accommodations.

**6.7 Safety data sheet.** Contracting officers will identify those activities requiring copies of completed Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

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6.8 Test report. Test data required by [4.5](#) should be available for the procurement activity and user in the same order as listed in [Table I](#). The Inspection Data on Aviation Turbine Fuels form published in ASTM D1655 should be used as a guide. Also, the type and amount of additives used should be reported.

6.9 Changes from previous issue. Marginal notes are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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APPENDIX A

FISCHER-TROPSCH SYNTHESIZED PARAFFINIC KEROSENE (FT-SPK)

#### A.1 SCOPE

A.1.1 Scope. This Appendix addresses requirements of 100 percent SPK derived from manufactured products of a Fischer-Tropsch (FT) process (identified in [3.1.1](#)) and test requirements in addition to [Table I](#) for finished fuels containing any amount of FT-SPK (not to exceed 50 volume percent). Blending of the FT-SPK with at least 50% petroleum sourced JP-8 must occur prior to any further blending with fuel containing any other synthetic blending component to ensure that the resulting blend always has at least 50% petroleum-sourced content. This Appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

#### A.2 REQUIREMENTS FOR FT-SPK

A.2.1 Chemical and physical requirements. The chemical and physical properties of the SPK shall be in accordance with those specified in [Table A-I](#).

A.2.2 Additives.

A.2.2.1 Antioxidants. Addition of antioxidants shall adhere to the criteria specified in [3.3.1](#).

A.2.2.2 Static dissipater additive. If 100% FT-SPK is to be transported prior to blending with refined hydrocarbon distillate fuel, static dissipater additive shall be injected in sufficient concentration to increase the conductivity of the fuel to within the range specified in [Table A-I](#). The point of injection of the additive shall be determined by agreement between the purchasing authority and the supplier. The following electrical conductivity additive is approved : Stadis® 450 marketed by Innospec Fuel Specialties, LLC.

**TABLE A-I. FT-SPK chemical and physical requirements and test methods.**

<b>Property</b>	<b>Min</b>	<b>Max</b>	<b>Test Method</b>
<b>COMPOSITION</b>			
Total acid number, mg KOH/g		0.015	D3242
Aromatics, mass percent		0.5	D2425
Cycloparaffins, mass percent		15	D2425
Paraffins, mass percent <sup>1</sup>			D2425
Carbon and Hydrogen, mass percent	99.5		D5291
Sulfur, total, mg/kg		15	D2622, D3120, or D5453 <sup>2</sup>
<b>VOLATILITY</b>			
Distillation temperature, °C <sup>3</sup>			D86 <sup>2,4</sup> or D2887
Initial boiling point <sup>1</sup>			
10 percent recovered		205	
20 percent recovered <sup>1</sup>			
50 percent recovered <sup>1</sup>			
90 percent recovered <sup>1</sup>			
Final boiling point		300	

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APPENDIX A

**TABLE A-I. FT-SPK chemical and physical requirements and test methods – Continued.**

<b>Property</b>	<b>Min</b>	<b>Max</b>	<b>Test Method</b>
VOLATILITY			
Residue, vol percent		1.5	
Loss, vol percent		1.5	
90 percent recovery gradient, °C <sup>5</sup>	22		
Flash point, °C <sup>6</sup>	38		D56, D93 <sup>2</sup> , D3828, or IP 170
Density			
Density, kg/L at 15 °C or	0.751	0.770	D1298 or D4052 <sup>2</sup>
Gravity, API at 60 °F	52.0	57.0	
FLUIDITY			
Freezing point, °C		-47	D2386 <sup>2</sup> or D5972
Viscosity at -20 °C, mm <sup>2</sup> /s		8.0	D445 <sup>2</sup> or D7042 <sup>7</sup>
Viscosity at 40 °C, mm <sup>2</sup> /s <sup>1</sup>			D445 <sup>2</sup> or D7042 <sup>7</sup>
COMBUSTION			
Net heat of combustion, MJ/kg	42.8		D3338 or D4809 <sup>2</sup>
THERMAL STABILITY			
Thermal stability (2.5 hr at 325 °C) <sup>8</sup>			D3241
Change in pressure drop, mm Hg		25	
Tube rating: One of the following requirements shall be met:			
(1) Annex A1 VTR or		<3 <sup>9</sup>	
(2) Annex A3 ETR or Annex A2 ITR, average deposit thickness, nm, over area of 2.5 mm <sup>2</sup>		85	
CONTAMINANTS			
Particulate matter, mg/L <sup>10</sup>		1.0	D2276 or D5452 <sup>2</sup>
Filtration time, minutes <sup>10</sup>		15	
Microseparometer Rating	85		D3948 or D7224 <sup>2</sup>
Nitrogen, mg/kg		2	D4629
Water, mg/kg		75	D6304
Phosphorus, mg/kg		0.1	D7111 or UOP 389
Metals (Al, Ca, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Pd, Pt, Sn, Sr, Ti, V, Zn), mg/kg		0.1 per metal	D7111 or UOP 389
Halogens, mg/kg		1	D7359
ADDITIVES			
Electrical conductivity, pS/m	50	600	D2624

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APPENDIX A**TABLE A-I. FT-SPK chemical and physical requirements and test methods – Continued.****NOTES:**

1. To be reported – not limited.
2. Referee Test Method.
3. Distillation property criteria are specified in ASTM D86 scale units. ASTM D2887 results shall be converted to estimated D86 results by application of the correlation in Appendix X4 "Correlation for Jet and Diesel Fuel (Procedures A and B)" of D2887 for comparison with the specified property criteria. Distillation residue and loss limits provide control of the distillation process during the D86 test method and do not apply to D2887.
4. ASTM D86 distillation is run at Group 4 conditions except that Group 3 condenser temperatures are used.
5. The temperature difference between the temperature that marks the 10 percent recovered point and the temperature that marks the 90 percent recovered point must be at least 22 °C.
6. ASTM D56 may give results up to 1 °C (2 °F) below the ASTM D93 results. ASTM D3828 may give results up to 1.7 °C (3 °F) below the ASTM D93 results. Method IP 170 is also permitted, may give results up to 2.2 °C (4 °F) below the ASTM D93 results.
7. ASTM D7042 results shall be corrected to bias-free viscosity results by the application of the correction factor in the D7042 Precision and Bias section.
8. See [4.5.3](#). ASTM D3241 Annex A3 Ellipsometric Tube Rater (ETR) is the referee thermal stability method, when available; otherwise, Annex A2 Interferometric Tube Rater (ITR), when available. Tube deposit failures by ETR or ITR shall be reported as ">85 nm." If the ITR reports "N/A" for the tube's volume thickness, the result constitutes a failure and the result shall be reported as ">85 nm." If test results by either ETR or ITR are reported, then results by Annex A1 Visual Tube Rater (VTR) are not required.
9. Peacock or Abnormal color deposits result in a failure.
10. A minimum sample size of 3.785 liters (1 gallon) shall be filtered. Filtration time will be determined in accordance with procedure in [Appendix C](#). This procedure may also be used for the determination of particulate matter as an alternate to ASTM D2276 or ASTM D5452.

**A.3 ADDITIONAL REQUIREMENTS FOR FINISHED FUEL CONTAINING FT-SPK.**

**A.3.1 Chemical and physical requirements.** The chemical and physical properties of finished fuel containing FT-SPK (FT-SPK must meet requirements of Table A-I and FT-SPK content of finished fuel may not exceed 50 volume percent) shall be in accordance with those specified in [Table I](#) and in addition those specified in [Table A-II](#).

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APPENDIX A

**TABLE A-II. Additional Chemical and physical requirements for JP-8 containing FT-SPK.**

<b>Property</b>	<b>Min</b>	<b>Max</b>	<b>Test Method</b>
COMPOSITION			
Aromatics, vol percent	8.0		D1319
VOLATILITY			
Distillation °C <sup>1</sup>			D86 <sup>2,3</sup> or D2887
50 percent recovery gradient <sup>4</sup>	15		
90 percent recovery gradient <sup>5</sup>	40		
COMBUSTION			
Derived cetane number	40		D6890 <sup>2</sup> or D7170
NOTES:			
1.	Distillation property criteria are specified in ASTM D86 scale units. ASTM D2887 results shall be converted to estimated D86 results by application of the correlation in Appendix X4 "Correlation for Jet and Diesel Fuel (Procedures A and B)" of D2887 for comparison with the specified property criteria. Distillation residue and loss limits provide control of the distillation process during the D86 test method and do not apply to D2887.		
2.	Referee Test Method.		
3.	ASTM D86 distillation is run at Group 4 conditions except that Group 3 condenser temperatures are used.		
4.	The temperature difference between the temperature that demarks the 10 percent recovered point and the temperature that demarks the 50 percent recovered point must be at least 15 °C.		
5.	The temperature difference between the temperature that demarks the 10 percent recovered point and the temperature that demarks the 90 percent recovered point must be at least 40 °C.		

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APPENDIX B

**HYDROPROCESSED ESTERS AND FATTY ACIDS SYNTHESIZED PARAFFINIC KEROSENE  
(HEFA-SPK)**

#### B.1 SCOPE

B.1.1 Scope. This Appendix addresses requirements of 100 percent HEFA-SPK derived from manufactured products of hydroprocessing animal fat, plant oil, or algal oil triglycerides (esters and fatty acids (identified in [3.1.1](#)) and test requirements in addition to [Table I](#) for finished fuels containing any amount of HEFA-SPK (not to exceed 50 volume percent). Blending of the HEFA-SPK with at least 50% petroleum sourced JP-8 must occur prior to any further blending with fuel containing any other synthetic blending component. This Appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

#### B.2 REQUIREMENTS FOR HEFA-SPK

B.2.1 Chemical and physical requirements. The chemical and physical properties of the HEFA-SPK shall be in accordance with those specified in [Table B-I](#).

##### B.2.2 Additives.

B.2.2.1 Antioxidants. Addition of antioxidants shall adhere to the criteria specified in [3.3.1](#).

B.2.2.2 Static dissipater additive. If 100% HEFA-SPK is to be transported prior to blending with refined hydrocarbon distillate fuel, static dissipater additive shall be injected in sufficient concentration to increase the conductivity of the fuel to within the range specified in [Table B-I](#). The point of injection of the additive shall be determined by agreement between the purchasing authority and the supplier. The following electrical conductivity additive is approved: Stadis® 450 marketed by Innospec Fuel Specialties, LLC.

**TABLE B-I. HEFA-SPK chemical and physical requirements and test methods.**

Property	Min	Max	Test Method
COMPOSITION			
Total acid number, mg KOH/g		0.015	D3242
Aromatics, mass percent		0.5	D2425
Cycloparaffins, mass percent		15	D2425
Paraffins, mass percent <sup>1</sup>			D2425
Carbon and Hydrogen, mass percent	99.5		D5291
Sulfur, total, mg/kg		15	D2622, D3120, or D5453 <sup>2</sup>
VOLATILITY			
Distillation temperature, °C <sup>3</sup>			D86 <sup>2,4</sup> or D2887
Initial boiling point <sup>1</sup>			
10 percent recovered		205	
20 percent recovered <sup>1</sup>			
50 percent recovered <sup>1</sup>			
90 percent recovered <sup>1</sup>			
Final boiling point		300	

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APPENDIX B

**TABLE B-I. HEFA-SPK chemical and physical requirements and test methods – Continued.**

<b>Property</b>	<b>Min</b>	<b>Max</b>	<b>Test Method</b>
VOLATILITY			
Residue, vol percent		1.5	
Loss, vol percent		1.5	
90 percent recovery gradient, °C <sup>5</sup>	22		
Flash point, °C <sup>6</sup>	38		D56, D93 <sup>2</sup> , D3828, or IP 170
Density			
Density, kg/L at 15 °C or	0.751	0.770	D1298 or D4052 <sup>2</sup>
Gravity, API at 60 °F	52.0	57.0	
FLUIDITY			
Freezing point, °C		-47	D2386 <sup>2</sup> or D5972
Viscosity at -20 °C, mm <sup>2</sup> /s		8.0	D445 <sup>2</sup> or D7042 <sup>7</sup>
Viscosity at 40 °C, mm <sup>2</sup> /s <sup>1</sup>			D445 <sup>2</sup> or D7042 <sup>7</sup>
COMBUSTION			
Net heat of combustion, MJ/kg	42.8		D3338 or D4809 <sup>2</sup>
THERMAL STABILITY			
Thermal stability (2.5 hr at 325 °C) <sup>8</sup>			D3241
Change in pressure drop, mm Hg		25	
Tube rating: One of the following requirements shall be met:			
(1) Annex A1 VTR or		<3 <sup>9</sup>	
(2) Annex A3 ETR or Annex A2 ITR, average deposit thickness, nm, over area of 2.5 mm <sup>2</sup>		85	
CONTAMINANTS			
Existent gum, mg/100 mL <sup>10</sup>		7	D381 <sup>2</sup> or IP 540
Fatty Acid Methyl Ester (FAME), mg/kg		5	IP 585 or IP 590
Particulate matter, mg/L <sup>11</sup>		1.0	D2276 or D5452 <sup>2</sup>
Filtration time, minutes <sup>11</sup>		15	
Microseparometer Rating	85		D3948 or D7224 <sup>2</sup>
Nitrogen, mg/kg		2	D4629
Water, mg/kg		75	D6304
Phosphorus, mg/kg		0.1	D7111 or UOP 389
Metals (Al, Ca, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Pd, Pt, Sn, Sr, Ti, V, Zn), mg/kg		0.1 per metal	D7111 or UOP 389
Halogens, mg/kg		1	D7359

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APPENDIX B**TABLE B-I. HEFA-SPK chemical and physical requirements and test methods – Continued.**

Property	Min	Max	Test Method
ADDITIVES			
Electrical conductivity, pS/m	50	600	D2624
NOTES:			
<p>1. To be reported – not limited.</p> <p>2. Referee Test Method.</p> <p>3. Distillation property criteria are specified in ASTM D86 scale units. ASTM D2887 results shall be converted to estimated D86 results by application of the correlation in Appendix X4 "Correlation for Jet and Diesel Fuel (Procedures A and B)" of D2887 for comparison with the specified property criteria. Distillation residue and loss limits provide control of the distillation process during the D86 test method and do not apply to D2887.</p> <p>4. ASTM D86 distillation is run at Group 4 conditions except that Group 3 condenser temperatures are used.</p> <p>5. The temperature difference between the temperature that demarks the 10 percent recovered point and the temperature that demarks the 90 percent recovered point must be at least 22 °C.</p> <p>6. ASTM D56 may give results up to 1 °C (2 °F) below the ASTM D93 results. ASTM D3828 may give results up to 1.7 °C (3 °F) below the ASTM D93 results. Method IP 170 is also permitted, may give results up to 2.2 °C (4 °F) below the ASTM D93 results.</p> <p>7. ASTM D7042 results shall be corrected to bias-free viscosity results by the application of the correction factor in the D7042 Precision and Bias section.</p> <p>8. See <a href="#">4.5.3</a>. ASTM D3241 Annex A3 Ellipsometric Tube Rater (ETR) is the referee thermal stability method, when available; otherwise, Annex A2 Interferometric Tube Rater (ITR), when available. Tube deposit failures by ETR or ITR shall be reported as "&gt;85 nm." If the ITR reports "N/A" for the tube's volume thickness, the result constitutes a failure and the result shall be reported as "&gt;85 nm." If test results by either ETR or ITR are reported, then results by Annex A1 Visual Tube Rater (VTR) are not required.</p> <p>9. Peacock or Abnormal color deposits result in a failure.</p> <p>10. The preferred vaporizing medium for aviation turbine fuel is steam; however, the existent gum test IP 540 may be performed using air as the vaporizing medium. If air is used instead of steam, it shall be recorded. Test Method ASTM D381, using steam jet operating conditions, shall be the referee test method.</p> <p>11. A minimum sample size of 3.785 liters (1 gallon) shall be filtered. Filtration time will be determined in accordance with procedure in <a href="#">Appendix C</a>. This procedure may also be used for the determination of particulate matter as an alternate to ASTM D2276 or ASTM D5452.</p>			

**B.3 ADDITIONAL REQUIREMENTS FOR FINISHED FUEL CONTAINING HEFA-SPK.**

**B.3.1 Chemical and physical requirements.** The chemical and physical properties of finished fuel containing HEFA-SPK (HEFA-SPK must meet requirements of [Table B-I](#) and HEFA-SPK content of finished fuel may not exceed 50 volume percent) shall be in accordance with those specified in [Table I](#) and in addition those specified in [Table B-II](#).

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APPENDIX B

**TABLE B-II. Additional chemical and physical requirements for JP-8 containing HEFA-SPK.**

<b>Property</b>	<b>Min</b>	<b>Max</b>	<b>Test Method</b>
COMPOSITION			
Aromatics, vol percent	8.0		D1319
VOLATILITY			
Distillation °C <sup>1</sup>			D86 <sup>2,3</sup> or D2887
50 percent recovery gradient <sup>4</sup>	15		
90 percent recovery gradient <sup>5</sup>	40		
COMBUSTION			
Derived cetane number	40		D6890 <sup>2</sup> or D7170
NOTES:			
1.	Distillation property criteria are specified in ASTM D86 scale units. ASTM D2887 results shall be converted to estimated D86 results by application of the correlation in Appendix X4 "Correlation for Jet and Diesel Fuel (Procedures A and B)" of D2887 for comparison with the specified property criteria. Distillation residue and loss limits provide control of the distillation process during the D86 test method and do not apply to D2887.		
2.	Referee Test Method.		
3.	ASTM D86 distillation is run at Group 4 conditions except that Group 3 condenser temperatures are used.		
4.	The temperature difference between the temperature that demarks the 10 percent recovered point and the temperature that demarks the 50 percent recovered point must be at least 15 °C.		
5.	The temperature difference between the temperature that demarks the 10 percent recovered point and the temperature that demarks the 90 percent recovered point must be at least 40 °C.		

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APPENDIX C

## METHOD FOR DETERMINATION OF FILTRATION TIME AND TOTAL SOLIDS

## C.1 SCOPE

C.1.1 Scope. This Appendix describes the method for determining singularly or simultaneously the filterability characteristics and solids contamination of jet fuel. The purpose is to detect and prevent contaminants in jet fuel that can plug and cause rupture of ground filtration equipment, thereby affecting flight reliability of aircraft. This Appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

## C.2 METHOD

C.2.1 Summary of method. 3.785 liters (1 gallon) of jet fuel is filtered through a membrane filter in the laboratory. The time required to filter this volume is measured in minutes and solids content is determined gravimetrically.

## C.3 APPARATUS

- a. Membrane filter: White, plain, 47 mm diameter, nominal pore size 0.8  $\mu\text{m}$ . The membrane filter must conform to ASTM D5452 requirements.
- b. Filtration apparatus: The apparatus, constructed of stainless steel, consists of a funnel and a funnel base with a filter support such that a membrane filter and a flow reducing washer can be securely held between the sealing surface of the funnel and funnel base (see Figure 1 "Apparatus for Determining Total Contaminant" in ASTM D5452).
- c. Flow reducing washer: A 47-mm diameter flow reducer washer with an effective filtration area of 4.8  $\text{cm}^2$  (Millipore Corporation Part No. XX1004710).
- d. Vacuum flask: A minimum of 4 liters.
- e. Vacuum system: That develops in excess of 67.5 kPa (20 inches of mercury) vacuum.
- f. Oven: Of the static type (without fan assisted circulation) controlling to  $90^\circ\text{C} \pm 5^\circ\text{C}$  ( $194^\circ\text{F} \pm 9^\circ\text{F}$ ).
- g. Forceps: Flat-bladed with non-serrated non-pointed tips.
- h. Dispenser, rinsing solvent (petroleum ether): Containing a 0.45  $\mu\text{m}$  membrane filter in the delivery line. If solvent has been pre-filtered using a 0.45  $\mu\text{m}$  filter then an inline filter is not required.
- i. Glass petri dish: Approximately 125 mm in diameter with removable cover.
- j. Analytical balance: Single or double pan, the precision standard deviation of which must be 0.07 mg or better.

## C.4 PREPARATION

C.4.1 Preparation of apparatus and sample containers. All components of the filtration apparatus (except the vacuum flask), sample containers and caps must be cleaned as described in paragraph 9 of ASTM D5452. All metal parts of the filtration apparatus are to be electrically bonded and grounded, including the fuel sample container. See ASTM D5452 for other safety precautions.

## C.5 SAMPLING

C.5.1 Sampling. Obtain a representative 3.785 liter (1 gallon) sample as directed in paragraph 8 of ASTM D5452. When sampling from a flowing stream is not possible, an all level sample or an average sample, in accordance with ASTM D4057 and/or ASTM D4177 shall be permitted. The 3.785 liter (1 gallon) sample container shall be an interior epoxy-coated metal can, a brown glass bottle, or a clear glass bottle protected by suitable means from exposure to light.

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APPENDIX C

## C.6 PROCEDURE

### C.6.1 Test procedure.

- a. Using forceps, place a new membrane (test) filter in a clean petri dish. Place the petri dish with the lid slightly ajar in a  $90^{\circ}\text{C} \pm 5^{\circ}\text{C}$  ( $194^{\circ}\text{F} \pm 9^{\circ}\text{F}$ ) oven for 30 minutes. Remove the petri dish from the oven and place it near the balance with the lid slightly ajar, but still protecting the filter from airborne contamination, for 30 minutes.
- b. Weigh the test filter. A filter weighing in excess of 90 mg will not be used for time filtration testing.
- c. Place a flow reducing washer (required only for time filtration testing) on top of funnel base then place a test filter on top of the reducing washer and secure the funnel to the funnel base.
- d. Immediately prior to filtering the fuel, shake the sample to obtain a homogeneous mix and assure that fuel temperature does not exceed  $30^{\circ}\text{C}$  ( $86^{\circ}\text{F}$ ). Clean the exterior or top portion of the sample container to ensure that no contaminants are introduced. Any free water present in the fuel sample will invalidate the filtration time results by giving an excessive filtration time rating.
- e. With the vacuum off, pour approximately 200 mL of fuel into the funnel.
- f. Turn vacuum on and record starting time. Continue filtration of the 3.785 liters (1 gallon) sample, periodically shaking the sample container to maintain a homogenous mix. Record the vacuum (kPa or inches of mercury) 1 minute after start and again immediately prior to completion of filtration. Throughout filtration, maintain a sufficient quantity of fuel in the funnel so that the membrane filter is always covered.
- g. Report the filtration time in minutes expressed to the nearest whole number. If filtration of the 3.785 liters (1 gallon) is not completed within 30 minutes, the test will be stopped and the volume of the fuel filtered will be measured. In these cases, report filtration time as ">30 minutes" and the total volume of fuel filtered.
- h. Report the vacuum (kPa or inches of mercury) as determined from the average of the two readings taken in C.6.1.f.
- i. After recording the filtration time, shut off the vacuum and rinse the sample container with approximately 100 mL of filtered petroleum ether and dispense into the filtration funnel. Turn vacuum on and filter the 100 mL rinse. Turn vacuum off and wash the inside of the funnel with approximately 50 mL of filtered petroleum ether. Turn vacuum on and filter. Repeat the funnel rinse with another 50 mL of petroleum ether but allow the rinse to soak the filter for approximately 30 seconds before turning the vacuum on to filter the rinse. With vacuum on, carefully remove the top funnel and rinse the periphery of the filter by directing a gentle stream of petroleum ether from the solvent dispenser from the edge of the filter toward the center, taking care not to wash contaminants off the filter. Maintain vacuum after final rinse for a few seconds to remove the excess petroleum ether from the filter.
- j. Using forceps, carefully remove test filter (from the funnel base and flow reducing washer if present) and place in a clean petri dish. Dry in the oven at  $90^{\circ}\text{C} \pm 5^{\circ}\text{C}$  ( $194^{\circ}\text{F} \pm 9^{\circ}\text{F}$ ) for 30 minutes with the cover on the petri dish slightly ajar. Remove the petri dish from the oven and place it near the balance with the lid slightly ajar, but still protecting the filter from airborne contamination, for 30 minutes. Reweigh the filter.
- k. Report the total solids content in mg/L by using the following formula:

$$\frac{\text{weight gain of filter in mg}}{3.785 \text{ L}} = \text{mg/L}$$

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- I. Should the sample exceed the 30-minute filtration time and a portion of the fuel is not filtered, the solids content in mg/liter will be figured as follows: Determine the volume of fuel filtered by subtracting the mL of fuel remaining from 3785 mL.

$$\frac{\text{weight gain of filter in mg}}{\text{mL of fuel filtered} \times 0.001} = \text{mg/L}$$

C.6.2 Test conditions for filtration time.

- a. The vacuum should exceed 67.5 kPa (20 inches of mercury) throughout the test. The differential pressure across the filter should exceed 67.5 kPa (20 inches of mercury).
- b. The fuel temperature shall be between 18 °C and 30 °C (64 °F and 86 °F). If artificial heat (such as a hot water bath) is used to heat the sample, erroneously high filtration times may occur, but this approach is allowed.

C.7 NOTES

C.7.1 Filtration time. If it is desired to determine the filtration time and not the total solids content, perform the test by omitting steps [C.6.1.i](#), [C.6.1.j](#), [C.6.1.k](#), and [C.6.1.l](#).

C.7.2 Total solids. If it is desired to determine the total solids content and not the filtration time, use of the flow reducing washer may be omitted. When a reducing ring is not used, then total solids shall be determined as per ASTM D5452 and the use of a control filter shall be required.

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CONCLUDING MATERIAL

Custodians:

Navy – AS  
Army – AT  
Air Force – 68  
DLA – PS

Preparing activity:

Air Force – 68  
(Project 9130-2015-002)

Review activities:

Army – AR, AV  
Air Force – 11, 20, 99, 184

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information using the ASSIST Online database at <https://assist.dla.mil>.

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# EXHIBIT 40

METRIC
MIL-DTL-16884N
22 April 2014
SUPERSEDING
MIL-DTL-16884M
14 August 2012

DETAIL SPECIFICATION  
FUEL, NAVAL DISTILLATE

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers one grade of naval distillate fuel: NATO symbol F-76.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

INTERNATIONAL STANDARDIZATION AGREEMENTS

- NATO STANAG 1135 - Interchangeability of Fuels, Lubricants and Associated Products Used by the Armed Forces of the North Atlantic Treaty Nations
- NATO STANAG 1385 - Guide Specification (Minimum Quality Standards) for Naval Distillate Fuels (F-75 and F-76)

DEPARTMENT OF DEFENSE SPECIFICATIONS

- MIL-PRF-32490 - Additive, Lubricity Improver, Diesel

DEPARTMENT OF DEFENSE STANDARDS

- MIL-STD-290 - Packaging and Marking of Petroleum and Related Products

(Copies of these documents are available online at <http://quicksearch.dla.mil>.)

Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to [CommandStandards@navy.mil](mailto:CommandStandards@navy.mil), with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

## MIL-DTL-16884N

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

## ASTM INTERNATIONAL

- ASTM D86 - Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure
- ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- ASTM D97 - Standard Test Method for Pour Point of Petroleum Products
- ASTM D130 - Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- ASTM D189 - Standard Test Method for Conradson Carbon Residue of Petroleum Products
- ASTM D287 - Standard Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)
- ASTM D445 - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- ASTM D482 - Standard Test Method for Ash from Petroleum Products
- ASTM D524 - Standard Test Method for Ramsbottom Carbon Residue of Petroleum Products
- ASTM D613 - Standard Test Method for Cetane Number of Diesel Fuel Oil
- ASTM D664 - Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration
- ASTM D974 - Standard Test Method for Acid and Base Number by Color-Indicator Titration
- ASTM D976 - Standard Test Method for Calculated Cetane Index of Distillate Fuels
- ASTM D1141 - Standard Practice for the Preparation of Substitute Ocean Water
- ASTM D1266 - Standard Test Method for Sulfur in Petroleum Products (Lamp Method)
- ASTM D1298 - Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- ASTM D1401 - Standard Test Method for Water Separability of Petroleum Oils and Synthetic Fluids
- ASTM D1500 - Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)
- ASTM D2274 - Standard Test Method for Oxidation Stability of Distillate Fuel Oil (Accelerated Method)
- ASTM D2425 - Standard Test Method for Hydrocarbon Types in Middle Distillates by Mass Spectrometry
- ASTM D2500 - Standard Test Method for Cloud Point of Petroleum Products
- ASTM D2622 - Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry

## MIL-DTL-16884N

ASTM D2709 - Standard Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge

ASTM D2887 - Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography

ASTM D3120 - Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry

ASTM D3605 - Standard Test Method for Trace Metals in Gas Turbine Fuels by Atomic Absorption and Flame Emission Spectroscopy

ASTM D3828 - Standard Test Methods for Flash Point by Small Scale Closed Cup Tester

ASTM D4052 - Standard Test Method for Density, Relative Density and API Gravity of Liquids by Digital Density Meter

ASTM D4057 - Standard Practice for Manual Sampling of Petroleum and Petroleum Products

ASTM D4176 - Standard Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)

ASTM D4177 - Standard Practice for Automatic Sampling of Petroleum and Petroleum Products

ASTM D4530 - Standard Test Method for Determination of Carbon Residue (Micro Method)

ASTM D4808 - Standard Test Methods for Hydrogen Content of Light Distillates, Middle Distillates, Gas Oils, and Residua by Low-Resolution Nuclear Magnetic Resonance Spectroscopy

ASTM D5291 - Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants

ASTM D5304 - Standard Test Method for Assessing Middle Distillate Fuel Storage Stability by Oxygen Overpressure

ASTM D5452 - Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration

ASTM D5453 - Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence

ASTM D5771 - Standard Test Method for Cloud Point of Petroleum Products (Optical Detection Stepped Cooling Method)

ASTM D5772 - Standard Test Method for Cloud Point of Petroleum Products (Linear Cooling Rate Method)

ASTM D5773 - Standard Test Method for Cloud Point of Petroleum Products (Constant Cooling Rate Method)

ASTM D5949 - Standard Test Method for Pour Point of Petroleum Products (Automatic Pressure Pulsing Method)

ASTM D5950 - Standard Test Method for Pour Point of Petroleum Products (Automatic Tilt Method)

ASTM D5985 - Standard Test Method for Pour Point of Petroleum Products (Rotational Method)

ASTM D6045 - Standard Test Method for Color of Petroleum Products by the Automatic Tristimulus Method

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- ASTM D6079 - Standard Test Method for Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFRR)
- ASTM D6217 - Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration
- ASTM D6450 - Standard Test Method for Flash Point by Continuously Closed Cup (CCCFP) Tester
- ASTM D6591 - Standard Test Method for Determination of Aromatic Hydrocarbon Types in Middle Distillates – High Performance Liquid Chromatography Method with Refractive Index Detection
- ASTM D6890 - Standard Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber
- ASTM D7039 - Standard Test Method for Sulfur in Gasoline, Diesel Fuel, Jet Fuel, Kerosine, Biodiesel, Biodiesel Blends, and Gasoline-Ethanol Blends by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry
- ASTM D7111 - Standard Test Method for Determination of Trace Elements in Middle Distillate Fuels by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)
- ASTM D7170 - Standard Test Method for Determination of Derived Cetane Number (DCN) of Diesel Fuel Oils-Fixed Range Injection Period, Constant Volume Combustion Chamber Method
- ASTM D7171 - Standard Test Method for Hydrogen Content of Middle Distillate Petroleum Products by Low-Resolution Pulsed Nuclear Magnetic Resonance Spectroscopy
- ASTM D7688 - Standard Test Method for Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFFR) by Visual Observation
- ASTM D7777 - Standard Test Method for Density, Relative Density, or API Gravity of Liquid Petroleum by Portable Digital Density Meter
- ASTM E29 - Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

(Copies of these documents are available online at [www.astm.org](http://www.astm.org).)

## BRITISH STANDARDS INSTITUTE

- BS EN 14078 - Liquid petroleum products - Determination of fatty acid methyl ester (FAME) content in middle distillates - Infrared spectrometry method

(Copies of this document are available online at <http://shop.bsigroup.com>.)

## ENERGY INSTITUTE

- IP 579 - Liquid petroleum products - Determination of fatty acid methyl ester (FAME) content in middle distillates - Infrared spectrometry Method

(Copies of this document are available online at [www.energypublishing.org](http://www.energypublishing.org).)

**2.4 Order of precedence.** Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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### 3. REQUIREMENTS

3.1 General. Requirements contained herein are not subject to corrections for tolerance of standard test methods. If multiple determinations are made by the inspecting laboratory, average results will be used except for those standard test methods where repeatability data are given. In those cases, the average value derived from the individual results that agree within the repeatability limits given may be used at the discretion of the inspection authority, provided an indication is given of the total number of results obtained and the number falling outside of the repeatability limits. The flash point value is absolute and no value less than 60.0 °C is permissible. For purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded “to the nearest unit” in the last right-hand digit used in expressing the specification limit, in accordance with the rounding method of ASTM E29.

3.2 Material. The fuel supplied under this specification shall consist of refined hydrocarbon distillate fuel, containing no residual fuel, and may contain only those additives specified in 3.2.2. The fuel shall be derived from conventional material sources, synthesized materials, or mixtures thereof. Conventional material sources are defined as crude oil, natural gas liquid condensates, heavy oil, shale oil, and oil sands. The fuel shall not contain any intentionally blended oxygenated compounds including fatty acid methyl esters (FAME), as specified in 3.2.3.

3.2.1 Synthesized materials. A maximum of 50 volume percent of the finished fuel (see 6.3.4) may consist of Synthesized Paraffinic Diesel (SPD) (see 6.3.9) blend components derived from Hydroprocessed Renewable Diesel (HRD) (see 6.3.6 and 6.3.7) or Fischer-Tropsch (FT) produced SPD. The remainder of the finished fuel must be comprised of conventional source blending components (see 6.3.3). Fischer-Tropsch Hydroprocessed Synthetic Paraffinic Diesel (FT-SPD) (see 6.3.5) and HRD derived blend components shall conform to the requirements in Appendix A. Finished fuel containing synthetic materials shall conform to the properties listed in [table I](#). If the finished fuel containing synthetic materials requires additives, then only the additives in accordance with 3.2.2 shall be used.

3.2.2 Additives. The additives listed herein may be used either singularly or in combination, provided the amounts do not exceed those specified herein. When specified (see 6.2), information concerning the type and dosage rate of each additive used shall be made available when requested by the procuring activity or user. All other additives are prohibited without prior approval from the cognizant activity below:

Cognizant activity for Fuel Additives:

Commander, Naval Sea Systems Command  
Ship Integrity and Performance Engineering (SEA 05P2)  
1333 Isaac Hull Avenue, SE, Bldg. 197, Washington Navy Yard, DC 20376

3.2.2.1 Metal deactivator. A metal deactivator, N, N-disalicylidene-1, 2 propanediamine, may be blended into the fuel provided the dosage rate does not exceed 5.8 milligrams of active ingredient per liter of fuel (2.2 grams per 100 U.S. gallons or 2 pounds per 1000 barrels).

3.2.2.2 Lubricity improver additives. Lubricity improver additives may be used to meet the lubricity requirement in [table I](#). The lubricity improver additive shall have an approved formulation in accordance with MIL-PRF-32490 and shall not exceed the maximum dosage rate prescribed by MIL-PRF-32490.

3.2.3 FAME. The recent mandatory and voluntary introduction of FAME (commonly known as biodiesel) in the commercial middle distillate marketplace has resulted in the potential for trace amounts of FAME in F-76 fuel. Fuel supplied under this specification shall not intentionally be blended with FAME. In the event of contamination with FAME, the fuel supplied under this specification shall not contain more than 0.1 volume percent FAME as determined by BS EN 14078 or IP 579.

3.3 Physical and chemical requirements. The naval distillate fuel shall conform to the physical and chemical requirements specified in [table I](#). These tests are performed on the finished product. Where more than one test method is allowed for a specific requirement, [table I](#) identifies the referee test method first, followed by the notation “(R)”.

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TABLE I. Physical and chemical requirements.

PHYSICAL REQUIREMENTS			
Characteristic	Requirement		ASTM Test Method
	Minimum	Maximum	
Appearance, at 25 °C or ambient, whichever is higher		Clear, bright, and free of visible particulates	D4176 <sup>1/</sup>
Demulsification, at 25 °C, minutes		10	D1401 <sup>2/</sup>
Density, at 15 °C, kg/m <sup>3</sup>	800	876	D1298 (R), D4052, D287, D7777
Distillation: 10% Recovered, °C 50% Recovered, °C 90% Recovered, °C End Point, °C Residue + Loss, volume %	Report Report	357 385 3.0	D86 (R) <sup>3/</sup> , D2887 <sup>4/</sup>
Cloud Point, °C		-1	D2500 (R), D5771 <sup>5/</sup> , D5772 <sup>5/</sup> , D5773 <sup>5/</sup>
Color		3	D1500 (R), D6045
Flash Point, °C	60.0		D93 (R) <sup>6/</sup> , D6450 <sup>6/</sup> , D3828 <sup>6/</sup>
Particulate Contamination, mg/L		10	D6217 (R), D5452 <sup>7/</sup>
Pour Point, °C		-6	D97 (R), D5949, D5950, D5985 <sup>8/</sup>
Viscosity, at 40 °C, mm <sup>2</sup> /second	1.7	4.3	D445
CHEMICAL REQUIREMENTS			
Acid Number, mg KOH/g		0.30	D974 (R) <sup>9/</sup> , D664
Ash, mass %		0.005	D482
Aromatics, mass %	8.1 <sup>10/</sup>		D6591 (R), D2425
Carbon Residue on 10% bottoms, mass %		0.20	D524 (R) <sup>11/</sup>
		0.14	D189, D4530 <sup>11/</sup>
Corrosion, 3 hours at 100 °C		No. 1	D130
Hydrogen Content, mass %	12.5		D7171 (R), D4808, D5291
Ignition Quality: Cetane Number, or Cetane Index, or Derived Cetane Number	42 43 42		D613 (R) D976 <sup>12/</sup> D6890, D7170
Storage Stability, total insolubles, mg/100 ml		3.0 1.5	D5304 (R) <sup>13/, 14/</sup> D2274 <sup>14/, 15/</sup>
Sulfur Content, mass %		0.0015 <sup>16/</sup>	D5453 (R), D1266, D2622, D3120, D7039
Trace Metals, mg/kg: Calcium Lead Sodium plus Potassium Vanadium		1.0 0.5 1.0 0.5	D7111 (R), D3605 <sup>17/</sup>
Lubricity, at 60 °C, micrometers		460	D6079 (R), D7688
Additive Names and Dosages	Report		

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TABLE I. Physical and chemical requirements – Continued.

## NOTES:

- <sup>1/</sup> If the sample has no visible particulates, but is otherwise not “clear and bright” (see 6.3.2) in accordance with ASTM D4176, Procedure 1, then the product shall meet the requirements of ASTM D2709, 0.05-volume percent of water and sediment, maximum. The fuel is acceptable for appearance if the water and sediment content is 0.05 percent volume or less. If the sample fails ASTM D4176, Procedure 1, because it contains visible sediment or particulate matter, but meets the requirements of 10 milligrams per liter (mg/L), maximum, in accordance with ASTM D6217 or ASTM D5452, then the fuel is considered acceptable provided all other physical and chemical requirements are met.
- <sup>2/</sup> The demulsification test shall be conducted in accordance with ASTM D1401 with the following exceptions:
  - (a) Synthetic seawater in accordance with ASTM D1141 shall be the emulsifying fluid.
  - (b) The test temperature shall be 25 °C.
  - (c) The demulsification time shall be that required for separation into two layers with no visible cuff at the interface. A lacy emulsion or cuff which does not form a band shall be disregarded. The fuel/water/emulsion layer volumes shall be recorded at 1-minute intervals and the demulsification time reported to the nearest minute.
- <sup>3/</sup> As the end point of the distillation is approached, if either a thermometer reading of 385 °C or a decomposition point is observed, the heating shall be discontinued and the procedure resumed as directed in ASTM D86.
- <sup>4/</sup> Results from ASTM D2887 shall be reported as “Predicted D86” results by application of the correlation in the Correlation for Jet and Diesel Fuel appendix of ASTM D2887 to convert the values. ASTM D86 shall remain as the referee method. Distillation residue and loss limits provide control of the distillation process during the ASTM D86 test method and do not apply to ASTM D2887.
- <sup>5/</sup> If either ASTM D5771, ASTM D5772, or ASTM D5773 is used, the temperature recorded in each respective test shall be rounded to the next lower integer and reported as the ASTM D2500 equivalent cloud point in accordance with ASTM D5771, ASTM D5772, or ASTM D5773.
- <sup>6/</sup> The flash point value is absolute and no value less than 60.0 °C is permissible.
- <sup>7/</sup> If ASTM D5452 is utilized, a minimum 1-liter sample will be used to meet the sample requirement of ASTM D6217.
- <sup>8/</sup> If either ASTM D5949, ASTM D5950, or ASTM D5985 is used, the results from these tests shall be based on the observations at 3 °C temperature intervals and reported as the ASTM D97 equivalent.
- <sup>9/</sup> The sample size when using ASTM D974 shall be 20.0±2.0 grams.
- <sup>10/</sup> Requirement applies only to finished fuels containing synthesized materials as defined in Appendix A.
- <sup>11/</sup> Fuel must meet the requirements for one of the two test methods. If ASTM D189 or ASTM D4530 is performed in lieu of the referee test method, ASTM D524, the maximum allowable carbon residue shall be 0.14 mass percent.
- <sup>12/</sup> ASTM D976 is only a valid method when 100 percent of the F-76 is derived from conventional material sources. ASTM D976 is not an acceptable cetane test method for fuels containing synthesized materials as defined in Appendix A.
- <sup>13/</sup> Only nylon membrane filter media (0.8-micrometer pore size) are acceptable as specified in ASTM D5304. Glass fiber (Type A/E) filter media shall not be used to obtain test results.
- <sup>14/</sup> Fuel must meet the requirements for one of the two test methods.
- <sup>15/</sup> If ASTM D2274 is utilized, the test period shall be extended from 16 hours to 40 hours.
- <sup>16/</sup> Availability of ultra-low sulfur (maximum 0.0015 mass percent) F-76 may be limited in certain regions. A waiver to deliver higher sulfur fuel may be granted on a case-by-case basis. Final authority to approve sulfur content waiver is granted by NAVSEA 05P2.
- <sup>17/</sup> Results by ASTM D3605 shall be reported in mg/L. Original limits in table I still apply.

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#### 4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as conformance inspection (see 4.4).

##### 4.2 Sampling.

4.2.1 Sampling for bulk lots. Bulk samples for tests shall be taken in accordance with ASTM D4057 for manual sampling and ASTM D4177 for automatic sampling (see 6.3.1).

4.2.2 Sampling for examination of packaged lots. A random sample of packaged containers shall be taken from each lot in accordance with [table II](#). The sample shall be examined in accordance with 4.3 (see 6.3.8).

TABLE II. Sampling for examination of packaged lots.

Lot Size	Sample Size
1-13	All
14-150	13
151-250	32
251-500	50
501-1,200	80
1,201-3,200	125
3,201-10,000	200
10,001-35,000	315
35,001 and over	500

4.3 Examination of the packaged lot. Samples taken in accordance with 4.2.2 shall be examined for compliance with MIL-STD-290 with regard to fill, closure, sealing, leakage, packaging, packing, and marking requirements as specified in 5.1. Any container having one or more defects, or under the required fill volume, shall be rejected (see 6.5).

4.4 Conformance inspection. Each sample selected as specified in 4.2 shall be tested as specified in [table I](#).

4.5 Ozone depleting substances (ODSs). In any of the test methods, the use of any ODS identified as a Class 1 or Class 2 ODS by the Environmental Protection Agency (EPA) is prohibited, as specified (see 6.2). An appropriate non-ODS solvent shall be substituted.

#### 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

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## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Naval distillate fuel is intended for use in all naval shipboard boilers, gas turbines, and diesel engines operating at ambient temperatures above -1 °C. Other uses may be specified according to the needs of the Department of Defense. Additives as specified in 3.2.2 are permitted. Gas turbines and diesel engines operating in ambient temperatures that fall consistently below -1 °C should utilize JP-5 fuel in accordance with MIL-DTL-5624.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Date of ordering and date of supply.
- b. Title, number, and date of this specification.
- c. Type and dosage rate of each additive used (see 3.2.2 and A.4.3).
- d. Prohibited ODSs (see 4.5).
- e. Packaging requirements (see 5.1).
- f. Examination lot acceptance/rejection criteria (see 6.5).

### 6.3 Definitions.

6.3.1 Bulk lot. A bulk lot should be considered an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single isolated container.

6.3.2 Clear and bright. The terms clear and bright are independent of the natural color of the fuel. Clear means the absence of any cloud, emulsion, or readily visible particulate matter or free water. Bright refers to the shiny appearance of clean, dry fuel.

6.3.3 Conventional source blending component. Blending streams derived from the following conventional sources: crude oil, petroleum, oil sands, oil shale, natural gas liquid condensates, or mixtures thereof.

6.3.4 Finished fuel. Fuel conforming to the requirements of section 3 and containing a maximum of 50 volume percent synthetic materials.

6.3.5 Fischer-Tropsch hydroprocessed synthetic paraffinic diesel (FT-SPD). SPD synthesized by FT processing. FT-SPD may also be referred to as paraffinic middle distillate (PMD).

6.3.6 Hydroprocessed. Conventional chemical processing in which hydrogen is reacted with organic compounds in the presence of a catalyst to remove impurities such as oxygen, sulfur, nitrogen; to saturate unsaturated hydrocarbons; or to alter the molecular structure of the hydrocarbon molecules.

6.3.7 Hydroprocessed or hydrotreated renewable diesel (HRD). SPD produced from mono-, di-, and triglycerides, free fatty acids, and fatty acid esters from plant, algal oils, or animal fats (for example, fatty acid methyl esters) that have been hydroprocessed to remove essentially all oxygen. HRD may also be referred to as hydroprocessed esters and fatty acids synthetic paraffinic diesel (HEFA-SPD) or PMD.

6.3.8 Packaged lot. A packaged lot should be considered an indefinite number of 208-liter (55-gallon) drums or smaller unit containers of identical size and type, offered for acceptance, and filled with a homogeneous mixture of material from one isolated container; or filled with a homogeneous mixture of material manufactured in a single plant run (not exceeding 24 hours) through the same processing equipment, with no change in ingredient material.

6.3.9 Synthesized paraffinic diesel (SPD). Middle distillate blending component consisting of n-paraffins, iso-paraffins, and cycloparaffins that meet the requirements of Appendix A. Hydrocarbons shall be derived from alternative sources such as coal, natural gas, biomass, and hydrogenated fats and oils by processes such as FT synthesis and hydroprocessing.

6.4 NAVSEA approval and direction. Deviation from specified materials, procedures, and requirements, and selection of specific alternative materials and procedures require NAVSEA approval or direction. Requests should include supporting documentation.

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**6.5 Recommended examination lot acceptance/rejection criteria.** If, as a result of the examination of the packaged lot, the number of defective or under-filled containers exceeds the reject limit number of table III, the lot represented by the sample should be rejected as specified (see 6.2).

TABLE III. Lot acceptance/rejection criteria.

Lot Size	Sample Size	Reject Limit
1-13	All	Any
14-150	13	1
151-250	32	2
251-500	50	3
501-1,200	80	4
1,201-3,200	125	6
3,201-10,000	200	11
10,001-35,000	315	15
35,001 and over	500	22

NOTES:

1. All defective items should be replaced with acceptable items prior to lot acceptance.
2. Inspect sample size until reject criteria are reached.
3. Rejected lots may be screened and resubmitted for inspection and retest.

**6.6 Subject term (key word) listing.**

Boiler

Diesel engine

Diesel fuel

Fischer-Tropsch Hydroprocessed Synthetic Paraffinic Diesel (FT-SPD)

Gas turbine engine

Hydroprocessed Esters and Fatty Acids (HEFA)

Hydroprocessed/Hydrotreated Renewable Diesel (HRD)

Lubricity

Marine diesel

Marine gas oil

Metal deactivator

Paraffinic Middle Distillate (PMD)

Refined hydrocarbon distillate fuel

Synthesized Paraffinic Diesel (SPD)

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6.7 International standardization agreement implementation. This specification implements NATO STANAG 1135, Interchangeability of Fuels, Lubricants and Associated Products Used by the Armed Forces of the North Atlantic Treaty Nations, and NATO STANAG 1385, Guide Specification for Naval Distillate Fuels (F-75 and F-76). When amendment, revision, or cancellation of this specification is proposed, the preparing activity must coordinate the action with the U.S. National Point of Contact for the international standardization agreement, as identified in the ASSIST database at <https://assist.dla.mil>.

6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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**APPENDIX A**

**HYDROPROCESSED SYNTHESIZED PARAFFINIC DIESEL (SPD)**

**A.1 SCOPE**

A.1.1 Scope. This appendix defines hydroprocessed Synthesized Paraffinic Diesel (SPD) for use as a synthetic blending component in marine diesel fuels. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

**A.2 APPLICABLE DOCUMENTS**

A.2.1 General. The documents listed in this section are specified in Appendix A of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in Appendix A of this specification, whether or not they are listed.

A.2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

**ASTM INTERNATIONAL**

- ASTM D86 - Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure
- ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- ASTM D130 - Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- ASTM D189 - Standard Test Method for Conradson Carbon Residue of Petroleum Products
- ASTM D287 - Standard Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)
- ASTM D445 - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- ASTM D524 - Standard Test Method for Ramsbottom Carbon Residue of Petroleum Products
- ASTM D664 - Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration
- ASTM D974 - Standard Test Method for Acid and Base Number by Color-Indicator Titration
- ASTM D1298 - Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- ASTM D2425 - Standard Test Method for Hydrocarbon Types in Middle Distillates by Mass Spectrometry
- ASTM D2500 - Standard Test Method for Cloud Point of Petroleum Products
- ASTM D2622 - Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry
- ASTM D3241 - Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels
- ASTM D3828 - Standard Test Methods for Flash Point by Small Scale Closed Cup Tester

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- ASTM D4052 - Standard Test Method for Density, Relative Density and API Gravity of Liquids by Digital Density Meter
- ASTM D4530 - Standard Test Method for Determination of Carbon Residue (Micro Method)
- ASTM D4629 - Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection
- ASTM D4808 - Standard Test Methods for Hydrogen Content of Light Distillates, Middle Distillates, Gas Oils, and Residua by Low-Resolution Nuclear Magnetic Resonance Spectroscopy
- ASTM D4809 - Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)
- ASTM D5291 - Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants
- ASTM D5452 - Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
- ASTM D5453 - Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
- ASTM D5771 - Standard Test Method for Cloud Point of Petroleum Products (Optical Detection Stepped Cooling Method)
- ASTM D5772 - Standard Test Method for Cloud Point of Petroleum Products (Linear Cooling Rate Method)
- ASTM D5773 - Standard Test Method for Cloud Point of Petroleum Products (Constant Cooling Rate Method)
- ASTM D6217 - Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration
- ASTM D6304 - Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration
- ASTM D6890 - Standard Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber
- ASTM D7111 - Standard Test Method for Determination of Trace Elements in Middle Distillate Fuels by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)
- ASTM D7170 - Standard Test Method for Determination of Derived Cetane Number (DCN) of Diesel Fuel Oils—Fixed Range Injection Period, Constant Volume Combustion Chamber Method
- ASTM D7171 - Standard Test Method for Hydrogen Content of Middle Distillate Petroleum Products by Low-Resolution Pulsed Nuclear Magnetic Resonance Spectroscopy

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ASTM D7261 - Standard Test Method for Determining Water Separation Characteristics of Diesel Fuels by Portable Separometer

(Copies of these documents are available online at [www.astm.org](http://www.astm.org).)

#### A.3 MATERIALS AND MANUFACTURE

A.3.1 Synthetic paraffinic materials. SPDs shall be derived from Fischer-Tropsch (FT) or Hydroprocessed Renewable Diesel (HRD) methods. FT-SPD blending components shall be wholly derived from synthesis gas via the FT process using iron or cobalt catalyst. HRD blend components shall be comprised of hydrocarbon fuel obtained from hydrogenation and deoxygenation of fatty acid esters and free fatty acids. Subsequent processing of the product shall include hydrotreating, hydrocracking, or hydroisomerization and is expected to include, but not be limited to, a combination of other conventional refinery processes such as polymerization, isomerization, and fractionation.

#### A.4 DETAILED BATCH REQUIREMENTS

A.4.1 Batch requirements. Each batch of synthetic blending component shall conform to the requirements prescribed in [table A-I](#).

A.4.2 Hydroprocessed SPD batch. The hydroprocessed SPD blend component shall meet the requirements of [table A-I](#). It is not necessary to analyze each batch of hydroprocessed SPD for compliance with [table A-II](#) once it is demonstrated that the process scheme is adequately controlled to support the expectation that these requirements are always met. At a minimum, batches shall be required to meet the specifications of [table A-II](#) when new production facilities or schemes are established, or when significant changes to existing production operations are implemented, such as the introduction of a new feedstock material.

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APPENDIX A

TABLE A-I. Detailed batch requirements: hydropyrolyzed SPD.

<b>Characteristic</b>	<b>Requirement</b>		<b>ASTM Method</b>
	<b>Minimum</b>	<b>Maximum</b>	
Acid Number, mg KOH/g		0.08	D974 (R), D664
Carbon Residue on 10% bottoms, mass %		0.20	D524 (R) <sup>1/</sup>
		0.14	D189 <sup>1/</sup> , D4530 <sup>1/</sup>
Cloud Point, °C		-1	D2500 (R), D5771, D5772, D5773
Corrosion, 3 hours at 100 °C		No. 1	D130
Density, at 15 °C, kg/m <sup>3</sup>	770	805	D1298 (R), D4052, D287
Derived Cetane Number	42	80	D6890, D7170
Distillation:			D86
Initial Boiling Point, °C	Report		
10% Recovered, °C	191	290	
50% Recovered, °C	Report		
90% Recovered, °C	290	357	
Final Boiling Point, °C	300	385	
T50-T10, °C	Report		
T90-T10, °C	20		
Residue + Loss, volume %		3.0	
Flash Point, °C	60.0		D93 (R) <sup>2/</sup> , D3828
Heating Value, MJ/kg	43.5		D4809
Hydrogen Content, mass %	14.5		D7171 (R), D4808, D5291
Kinematic Viscosity, at 40 °C, mm <sup>2</sup> /s	1.7	4.3	D445
DSEP	85		D7261
Particulate Contamination, mg/L		1.0	D6217 (R), D5452
Thermal Stability:			D3241 <sup>3/</sup>
Change in Pressure Drop, mm of Hg		25	
Tube Deposit Code, less than		3 <sup>4/</sup>	
Total Water, mg/kg		100	D6304
NOTES:			
<sup>1/</sup>	Fuel must meet the requirements for one of the three test methods. If ASTM D189 or ASTM D4530 is performed in lieu of the referee test method, ASTM D524, the maximum allowable carbon residue shall be 0.14 mass percent.		
<sup>2/</sup>	ASTM D3828 may give results up to 1.7 °C below the ASTM D93 results.		
<sup>3/</sup>	See A.4.5.1 and A.4.5.2 for ASTM D3241 test conditions and procedures.		
<sup>4/</sup>	If the visual rating of the heater tube shows Peacock (P) or Abnormal (A) type deposits, the fuel sample is not acceptable.		

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APPENDIX ATABLE A-II. Other detailed requirements; hydroprocessed SPD.

Characteristic	Requirement		ASTM Method
	Minimum	Maximum	
<b>Hydrocarbon Composition</b>			
Cycloparaffins, mass %		15 <sup>1/</sup>	D2425
Aromatics, mass %		0.5	D2425
Paraffins (normal and iso), mass %	Report		D2425
Carbon and Hydrogen, mass %	99.5		D5291
<b>Non-Hydrocarbon Composition</b>			
Nitrogen, mg/kg		10	D4629
Sulfur, mg/kg		15	D5453, D2622
Metals <sup>2/</sup> (Al, Ca, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, P, Pb, Pd, Pt, Sn, Sr, Ti, V, Zn), mg/kg		0.1 per metal	D7111
Alkali Metals and Metalloids <sup>2/</sup> (B, Na, K, Si, Li), mg/kg		1 total	D7111
NOTES:			
<sup>1/</sup> Maximum cycloparaffin composition is based on current experience with the approved synthetic fuels and is within the range of what is typical for refined diesel fuel.			
<sup>2/</sup> All detected metals below the detection limits shall be considered as 0 µg/kg. Only the metals whose measured values are higher than their respective detection limits shall be considered as legitimate values for calculation.			

A.4.3 Additives. When specified (see 6.2), information concerning the type and dosage rate of each additive used shall be made available.

A.4.4 Antioxidants. Antioxidant shall be added as soon as practicable after hydroprocessing or fractionation synthesizing and prior to the product or component being passed into storage to prevent peroxidation and gum formation after manufacture. Not less than 17.2 mg/L or more than 24.0 mg/L of active ingredient shall be used. The following antioxidant formulations are approved:

- a. 2,6-di-tert-butyl-4-methylphenol
- b. 6-tert-butyl-2,4-dimethylphenol
- c. 2,6-di-tert-butylphenol
- d. 75 percent minimum 2,6-di-tert-butylphenol  
25 percent maximum tert-butylphenols and tri-tert-butylphenols
- e. 72 percent minimum 6-tert-butyl-2,4-dimethylphenol  
28 percent maximum tert-butyl-methylphenols and tert-butyl-dimethylphenols
- f. 55 percent minimum 2,4-dimethyl-6-tert-butylphenol and  
15 percent minimum 2,6-di-tert-butyl-4-methylphenol and  
30 percent maximum mixed methyl and dimethyl tert-butylphenols

A.4.5 Thermal stability. The thermal stability test shall be conducted using ASTM D3241 (Thermal Oxidation Stability of Aviation Fuels Test). The heater tube shall be rated visually (see Test Method for Visual Rating of ASTM D3241 Heater Tubes Annex of ASTM D3241).

A.4.5.1 Test conditions.

- a. Minimum heater tube temperature at maximum point: 325 °C

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APPENDIX A

- b. Fuel system pressure: 3.45 MPa (500 psig)
- c. Fuel flow rate: 3.0 mL/minute
- d. Test duration: 150 minutes

A.4.5.2 ASTM D3241 procedure.

- a. The differential pressure in mm Hg at 150 minutes or time to differential pressure of 25 mm Hg, whichever comes first, shall be recorded.
- b. The heater tube deposit code rating shall be recorded at the end of the test.

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Custodians:

Army – CR4  
Navy – SH  
Air Force – 68

Preparing activity:

Navy – SH  
(Project 9140-2013-002)

Review activities:

Army – AT  
Navy – CG, MC, SA  
DLA – GS, PS

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.

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# EXHIBIT 41

METRIC
MIL-DTL-16884P
26 September 2017
SUPERSEDING
MIL-DTL-16884N
22 April 2014

DETAIL SPECIFICATION  
FUEL, NAVAL DISTILLATE

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers one grade of naval distillate fuel: NATO symbol F-76.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-32490 - Additive, Lubricity Improver, Diesel

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-290 - Packaging and Marking of Petroleum and Related Products

(Copies of these documents are available online at <http://quicksearch.dla.mil/>.)

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to [CommandStandards@navy.mil](mailto:CommandStandards@navy.mil), with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

AMSC N/A

FSC 9140

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**2.2.2 Other Government documents, drawings, and publications.** The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

## NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

T9070-AL-DPC-020/077-2 - NAVSEA Hazardous Material Avoidance Process

(Copies of this document are available online via Technical Data Management Information System (TDMIS) at <https://mercury.tdmis.navy.mil/> by searching for the document number without the suffix. Refer questions, inquiries, or problems to: DSN 296-0669, Commercial (805) 228-0669. This document is available for ordering (hard copy) via the Naval Logistics Library at <https://nll.afh.nmci.navy.mil>. For questions regarding the NLL, contact the NLL Customer Service at [nllhelpdesk@navy.mil](mailto:nllhelpdesk@navy.mil), (866) 817-3130, or (215) 697-2626/DSN 442-2626.)

**2.3 Non-Government publications.** The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

## ASTM INTERNATIONAL

- ASTM D86 - Standard Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure
- ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- ASTM D97 - Standard Test Method for Pour Point of Petroleum Products
- ASTM D130 - Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- ASTM D189 - Standard Test Method for Conradson Carbon Residue of Petroleum Products
- ASTM D287 - Standard Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)
- ASTM D445 - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- ASTM D482 - Standard Test Method for Ash from Petroleum Products
- ASTM D524 - Standard Test Method for Ramsbottom Carbon Residue of Petroleum Products
- ASTM D613 - Standard Test Method for Cetane Number of Diesel Fuel Oil
- ASTM D664 - Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration
- ASTM D974 - Standard Test Method for Acid and Base Number by Color-Indicator Titration
- ASTM D976 - Standard Test Method for Calculated Cetane Index of Distillate Fuels
- ASTM D1141 - Standard Practice for the Preparation of Substitute Ocean Water
- ASTM D1266 - Standard Test Method for Sulfur in Petroleum Products (Lamp Method)
- ASTM D1298 - Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- ASTM D1401 - Standard Test Method for Water Separability of Petroleum Oils and Synthetic Fluids

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- ASTM D1500 - Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)
- ASTM D2274 - Standard Test Method for Oxidation Stability of Distillate Fuel Oil (Accelerated Method)
- ASTM D2425 - Standard Test Method for Hydrocarbon Types in Middle Distillates by Mass Spectrometry
- ASTM D2500 - Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels
- ASTM D2622 - Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry
- ASTM D2709 - Standard Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge
- ASTM D2887 - Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography
- ASTM D3120 - Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry
- ASTM D3605 - Standard Test Method for Trace Metals in Gas Turbine Fuels by Atomic Absorption and Flame Emission Spectroscopy
- ASTM D3828 - Standard Test Methods for Flash Point by Small Scale Closed Cup Tester
- ASTM D4052 - Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
- ASTM D4057 - Standard Practice for Manual Sampling of Petroleum and Petroleum Products
- ASTM D4176 - Standard Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)
- ASTM D4177 - Standard Practice for Automatic Sampling of Petroleum and Petroleum Products
- ASTM D4530 - Standard Test Method for Determination of Carbon Residue (Micro Method)
- ASTM D4808 - Standard Test Methods for Hydrogen Content of Light Distillates, Middle Distillates, Gas Oils, and Residua by Low-Resolution Nuclear Magnetic Resonance Spectroscopy
- ASTM D5291 - Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants
- ASTM D5304 - Standard Test Method for Assessing Middle Distillate Fuel Storage Stability by Oxygen Overpressure
- ASTM D5452 - Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
- ASTM D5453 - Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
- ASTM D5771 - Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels (Optical Detection Stepped Cooling Method)
- ASTM D5772 - Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels (Linear Cooling Rate Method)

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- ASTM D5773 - Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels (Constant Cooling Rate Method)
- ASTM D5949 - Standard Test Method for Pour Point of Petroleum Products (Automatic Pressure Pulsing Method)
- ASTM D5950 - Standard Test Method for Pour Point of Petroleum Products (Automatic Tilt Method)
- ASTM D5985 - Standard Test Method for Pour Point of Petroleum Products (Rotational Method)
- ASTM D6045 - Standard Test Method for Color of Petroleum Products by the Automatic Tristimulus Method
- ASTM D6079 - Standard Test Method for Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFRR)
- ASTM D6217 - Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration
- ASTM D6450 - Standard Test Method for Flash Point by Continuously Closed Cup (CCCFP) Tester
- ASTM D6591 - Standard Test Method for Determination of Aromatic Hydrocarbon Types in Middle Distillates – High Performance Liquid Chromatography Method with Refractive Index Detection
- ASTM D6751 - Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels
- ASTM D6890 - Standard Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber
- ASTM D7039 - Standard Test Method for Sulfur in Gasoline, Diesel Fuel, Jet Fuel, Kerosine, Biodiesel, Biodiesel Blends, and Gasoline-Ethanol Blends by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry
- ASTM D7042 - Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)
- ASTM D7111 - Standard Test Method for Determination of Trace Elements in Middle Distillate Fuels by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)
- ASTM D7170 - Standard Test Method for Determination of Derived Cetane Number (DCN) of Diesel Fuel Oils-Fixed Range Injection Period, Constant Volume Combustion Chamber Method
- ASTM D7171 - Standard Test Method for Hydrogen Content of Middle Distillate Petroleum Products by Low-Resolution Pulsed Nuclear Magnetic Resonance Spectroscopy
- ASTM D7688 - Standard Test Method for Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFFR) by Visual Observation
- ASTM D7777 - Standard Test Method for Density, Relative Density, or API Gravity of Liquid Petroleum by Portable Digital Density Meter
- ASTM D7963 - Standard Test Method for Determination of Contamination Level of Fatty Acid Methyl Esters in Middle Distillate and Residual Fuels by Fourier Transform Infrared Spectroscopy-Rapid Screening Method

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ASTM E29 - Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

(Copies of these documents are available online at <http://www.astm.org>.)

#### BRITISH STANDARDS INSTITUTE

BS EN 14078 - Liquid Petroleum Products - Determination of Fatty Acid Methyl Ester (FAME) Content in Middle Distillates - Infrared Spectrometry Method

BS EN 14214 - Liquid Petroleum Products - Fatty Acid Methyl Esters (FAME) for use in Diesel Engines and Heating Applications – Requirements and Test Methods

(Copies of these documents are available online at <http://shop.bsigroup.com>.)

#### ENERGY INSTITUTE

IP 579 - Liquid Petroleum Products - Determination of Fatty Acid Methyl Ester (FAME) Content in Middle Distillates - Infrared Spectrometry Method

(Copies of this document are available online at <http://www.energypublishing.org>.)

**2.4 Order of precedence.** Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

**3.1 General.** Requirements contained herein are not subject to corrections for tolerance of standard test methods. If multiple determinations are made by the inspecting laboratory, average results will be used except for those standard test methods where repeatability data are given. In those cases, the average value derived from the individual results that agree within the repeatability limits given may be used at the discretion of the inspection authority, provided an indication is given of the total number of results obtained and the number falling outside of the repeatability limits. The flash point value is absolute and no value less than 60.0 °C is permissible. For purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded “to the nearest unit” in the last right-hand digit used in expressing the specification limit, in accordance with the rounding method of ASTM E29.

**3.2 Material.** The fuel supplied under this specification shall consist of refined hydrocarbon distillate fuel, containing no residual fuel, and may contain only those additives specified in 3.2.4. The fuel shall be derived from conventional material sources, synthesized materials, or mixtures thereof. Conventional material sources are defined as crude oil, natural gas liquid condensates, heavy oil, shale oil, and oil sands. The fuel shall not contain any intentionally blended oxygenated compounds including fatty acid methyl esters (FAME), as specified in 3.2.5.

#### 3.2.1 Toxicity and prohibited materials.

**3.2.1.1 Toxicity.** When evaluated in accordance with 4.4, the fuel shall pose no serious or high risk to the health of personnel or the environment when used for its intended purpose (see 4.4 and 6.6).

**3.2.1.2 Prohibited materials.** The fuel shall not contain any chemicals categorized as “prohibited” in accordance with T9070-AL-DPC-020/077-2.

**3.2.2 Synthesized paraffinic diesels (SPDs).** A maximum of 50 volume percent of the finished fuel (see 6.3.5) may consist of SPD (see 6.3.12) blend components derived from Hydroprocessed Renewable Diesel (HRD) (see 6.3.7 and 6.3.9) or Fischer-Tropsch (FT) produced SPD. The remainder of the finished fuel shall be comprised of conventional source blending components (see 6.3.3). Fischer-Tropsch Hydroprocessed Synthesized Paraffinic Diesel (FT-SPD) (see 6.3.6) and HRD derived blend components shall conform to the requirements in Appendix A. Finished fuel containing SPD shall conform to the properties listed in [table I](#). If the finished fuel containing SPD requires additives, then only additives in accordance with 3.2.3 shall be used.

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3.2.3 Synthesized iso-paraffins (SIP) from hydroprocessed fermented sugars. A maximum of 20 volume percent of the finished fuel (see 6.3.5) may consist of SIP (see 6.3.11) blend components derived from hydroprocessed fermented sugars (see 6.3.8). The remainder of the finished fuel shall be comprised of conventional source blending components (see 6.3.3). SIP-derived blend components shall conform to the requirements in Appendix B. Finished fuel containing SIP shall conform to the properties listed in table I. If the finished fuel containing SIP requires additives, then only additives in accordance with 3.2.3 shall be used.

3.2.4 Fuel additives. Additives listed herein may be used either singularly or in combination, provided the amounts do not exceed those specified herein. When specified (see 6.2), information concerning the name and dosage rate of each additive used shall be made available when requested by the procuring activity or user. All other additives are prohibited without prior approval from the cognizant activity below:

Cognizant activity for fuel additives:

Commander, Naval Sea Systems Command  
Ship Integrity and Performance Engineering (SEA 05P2)  
1333 Isaac Hull Avenue, SE, Bldg. 197, Washington Navy Yard, DC 20376

3.2.4.1 Metal deactivator. A metal deactivator, N, N-disalicylidene-1, 2 propanediamine, may be blended into the fuel provided the dosage rate does not exceed 5.8 milligrams of active ingredient per liter of fuel (2.2 grams per 100 U.S. gallons or 2 pounds per 1,000 barrels).

3.2.4.2 Lubricity improver additives. Lubricity improver additives may be used to meet the lubricity requirement in table I. The lubricity improver additive shall have an approved formulation in accordance with MIL-PRF-32490 and shall not exceed the maximum dosage rate prescribed by MIL-PRF-32490.

3.2.5 FAME. Fuel supplied under this specification shall not intentionally be blended with FAME. The fuel supplied under this specification shall not contain more than 0.1 volume percent FAME (see 3.2 and 6.3.4), as determined by BS EN 14078, IP 579, or ASTM D7963. FAME that fail to meet the biodiesel quality standards (ASTM D6751 or BS EN 14214) are not permitted in naval distillate fuel and are subject to the same de minimis limit of 0.1 volume percent. Where a risk exists for incidental FAME contamination, the supplier shall ensure this limit is not exceeded prior to product availability.

3.3 Physical and chemical requirements. The naval distillate fuel shall conform to the physical and chemical requirements specified in table I.

TABLE I. Physical and chemical requirements.

Characteristic	Physical Requirements		ASTM Test Method	
	Requirement			
	Minimum	Maximum		
Appearance, at 25 °C or ambient, whichever is higher	Clear, bright, and free of visible particulates		ASTM D4176 <sup>1/</sup>	
Demulsification, at 25 °C, minutes		10	ASTM D1401 <sup>2/</sup>	
Density, at 15 °C, kg/m <sup>3</sup>	800.0	876.0	ASTM D1298 (R), ASTM D4052, ASTM D287, ASTM D7777	
Distillation: 10% Recovered, °C 50% Recovered, °C 90% Recovered, °C End Point, °C Residue + Loss, volume %	Record Record	357.0 385.0 3.0	ASTM D86 (R) <sup>3/</sup> , ASTM D2887 <sup>4/</sup>	

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TABLE I. Physical and chemical requirements – Continued.

<b>Physical Requirements</b>			
<b>Characteristic</b>	<b>Requirement</b>		<b>ASTM Test Method</b>
	<b>Minimum</b>	<b>Maximum</b>	
Cloud Point, °C		-1	ASTM D2500 (R), ASTM D5771 <sup>5/</sup> , ASTM D5772 <sup>5/</sup> , ASTM D5773 <sup>5/</sup>
Color		3	ASTM D1500 (R), ASTM D6045
Flash Point, °C	60.0		ASTM D93 (R) <sup>6/</sup> , ASTM D6450 <sup>6/</sup> , ASTM D3828 <sup>6/</sup>
Particulate Contamination, mg/L		10.0	ASTM D6217 (R), ASTM D5452 <sup>7/</sup>
Pour Point, °C		-6	ASTM D97 (R), ASTM D5949, ASTM D5950, ASTM D5985 <sup>8/</sup>
Viscosity, at 40 °C, mm <sup>2</sup> /second	1.700	4.300	ASTM D445, ASTM D7042
<b>CHEMICAL REQUIREMENTS</b>			
Acid Number, mg KOH/g		0.30	ASTM D974 (R) <sup>9/</sup> , ASTM D664
Ash, mass %		0.005	ASTM D482
Aromatics, mass %	8.1 <sup>10/</sup>		ASTM D6591 (R), ASTM D2425
Carbon Residue on 10% bottoms, mass %		0.20	ASTM D524 (R) <sup>11/</sup>
		0.14	ASTM D189, ASTM D4530 <sup>11/</sup>
Corrosion, 2 hours at 100 °C		No. 1	ASTM D130
Hydrogen Content, mass %	12.50		ASTM D7171 (R), ASTM D4808, ASTM D5291
Ignition Quality:			
Cetane Number, or	42		ASTM D613 (R)
Cetane Index, or	43.0		ASTM D976 <sup>12/</sup>
Derived Cetane Number	42.0		ASTM D6890, ASTM D7170
Storage Stability, Total Insolubles, mg/100 ml		2.0	ASTM D5304 (R) <sup>13/, 14/</sup>
		1.0	ASTM D2274 <sup>14/, 15/</sup>
Sulfur Content, mg/kg		15 <sup>16/</sup>	ASTM D5453 (R), ASTM D1266, ASTM D2622, ASTM D3120, ASTM D7039
Trace Metals, mg/kg:			ASTM D7111 (R), ASTM D3605 <sup>17/</sup>
Calcium		1.00	
Lead		0.50	
Sodium plus Potassium		1.00	
Vanadium		0.50	
Lubricity, at 60 °C, micrometers		460	ASTM D6079 (R), ASTM D7688
Additive Names and Dosage Rates	Record		

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TABLE I. Physical and chemical requirements – Continued.

## FOOTNOTES:

1/ If the sample has no visible particulates, but is otherwise not “clear and bright” (see 6.3.2) in accordance with ASTM D4176, Procedure 1, then the product shall meet the requirements of ASTM D2709, 0.05 volume percent of water and sediment, maximum. The fuel is acceptable for appearance if the water and sediment content is 0.05 volume percent or less. If the sample fails ASTM D4176, Procedure 1, because it contains visible sediment or particulate matter, but meets the requirements of 10 milligrams per liter (mg/L), maximum, in accordance with ASTM D6217 or ASTM D5452, then the fuel is considered acceptable provided all other physical and chemical requirements are met.

2/ The demulsification test shall be conducted in accordance with ASTM D1401 with the following exceptions:

- Synthetic seawater in accordance with ASTM D1141 shall be the emulsifying fluid.
- The test temperature shall be 25 °C.
- The demulsification time shall be that required for separation into two layers with no visible cuff at the interface. A lacy emulsion or cuff which does not form a band shall be disregarded. The fuel/water/emulsion layer volumes shall be recorded at 1-minute intervals and the demulsification time recorded to the nearest minute.

3/ As the end point of the distillation is approached, if either a thermometer reading of 385 °C or a decomposition point is observed, the heating shall be discontinued and the procedure resumed as directed in ASTM D86.

4/ Results from ASTM D2887 shall be recorded as “Predicted D86” results by application of the correlation in the Correlation for Jet and Diesel Fuel appendix of ASTM D2887 to convert the values. ASTM D86 shall remain as the referee method. Distillation residue and loss limits provide control of the distillation process during the ASTM D86 test method and do not apply to ASTM D2887.

5/ If either ASTM D5771, ASTM D5772, or ASTM D5773 is used, the temperature recorded in each respective test shall be rounded to the next lower integer and recorded as the ASTM D2500 equivalent cloud point in accordance with ASTM D5771, ASTM D5772, or ASTM D5773.

6/ The flash point value is absolute and no value less than 60.0 °C is permissible.

7/ If ASTM D5452 is utilized, a minimum 1-liter sample will be used to meet the sample requirement of ASTM D6217.

8/ If either ASTM D5949, ASTM D5950, or ASTM D5985 is used, the results from these tests shall be based on the observations at 3 °C temperature intervals and recorded as the ASTM D97 equivalent.

9/ The sample size when using ASTM D974 shall be 20.0±2.0 grams.

10/ Requirement applies only to finished fuels containing synthesized materials as defined in Appendix A or Appendix B.

11/ Fuel shall meet the requirements for one of the two test methods. If ASTM D189 or ASTM D4530 is performed in lieu of the referee test method, ASTM D524, the maximum allowable carbon residue shall be 0.14 mass percent.

12/ ASTM D976 is only a valid method when 100 percent of the F-76 is derived from conventional material sources. ASTM D976 is not an acceptable cetane test method for fuels containing synthesized materials as defined in Appendix A or Appendix B.

13/ Only nylon membrane filter media (0.8-micrometer pore size) are acceptable as in accordance with ASTM D5304. Glass fiber (type A/E) filter media shall not be used to obtain test results.

14/ Fuel shall meet the requirements for one of the two test methods.

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TABLE I. Physical and chemical requirements – Continued.

<sup>15/</sup> If ASTM D2274 is utilized, the test period shall be extended from 16 hours to 40 hours.

<sup>16/</sup> Availability of ultra-low sulfur (maximum 15 mg/kg) F-76 may be limited in certain regions. A waiver to deliver higher sulfur fuel may be granted on a case-by-case basis. Final authority to approve a sulfur content waiver is granted by NAVSEA 05P2.

<sup>17/</sup> Results by ASTM D3605 shall be recorded in mg/L. Original limits in [table I](#) still apply.

NOTE: Table I identifies the referee test method first, followed by the notation "(R)." "(R)" denotes the referee test method.

## 4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as conformance inspection (see 4.5).

4.2 Sampling.

4.2.1 Sampling for bulk lots. Bulk samples for tests shall be taken in accordance with ASTM D4057 for manual sampling and ASTM D4177 for automatic sampling (see 6.3.1).

4.2.2 Sampling for examination of packaged lots. A random sample of packaged containers shall be taken from each lot in accordance with [table II](#). The sample shall be examined in accordance with 4.3 (see 6.3.10).

TABLE II. Sampling for examination of packaged lots.

Lot Size	Sample Size
1-13	All
14-150	13
151-250	32
251-500	50
501-1,200	80
1,201-3,200	125
3,201-10,000	200
10,001-35,000	315
35,001 and over	500

4.3 Examination of the packaged lot. Samples taken in accordance with 4.2.2 shall be examined for compliance with MIL-STD-290 with regard to fill, closure, sealing, leakage, packaging, packing, and marking requirements as specified in 5.1. Any container having one or more defects, or under the required fill volume, shall be rejected (see 6.5).

4.4 Toxicity and prohibited materials. A Health Hazard Assessment (HHA) will be conducted to ensure conformance to 3.2.1.1 and 3.2.1.2, as specified (see 6.2). The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the fuel using data provided by the manufacturer/distributor to the NMCPHC (see 3.2.1.1 and 6.6).

4.5 Conformance inspection. Each sample selected as specified in 4.2 shall be tested as specified in [table I](#). These tests are performed on the finished product. Where more than one test method is allowed for a specific requirement, [table I](#) identifies the referee test method first, followed by the notation "(R)".

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**4.6 Ozone depleting substances (ODSs).** In any of the test methods, the use of any ODS identified as a class 1 or class 2 ODS by the Environmental Protection Agency (EPA) is prohibited, as specified (see 6.2). An appropriate non-ODS solvent shall be substituted.

## 5. PACKAGING

**5.1 Packaging.** For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

**6.1 Intended use.** Naval distillate fuel is intended for use in all naval shipboard boilers, gas turbines, and diesel engines operating at ambient temperatures above -1 °C. Other uses may be specified according to the needs of the Department of Defense. Additives as specified in 3.2.3 are permitted. Gas turbines, diesel engines, and boilers operating in ambient temperatures that fall consistently below -1 °C should utilize JP-5 fuel in accordance with MIL-DTL-5624.

**6.2 Acquisition requirements.** Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Date of ordering and date of supply.
- c. Requirements for an HHA (see 3.2.1 and 4.4).
- d. Type and dosage rate of each additive used (see 3.2.3, A.4.3, and B.4.3).
- e. Prohibited ODSs (see 4.6).
- f. Packaging requirements (see 5.1).
- g. Examination lot acceptance/rejection criteria (see 6.5).

### 6.3 Definitions.

**6.3.1 Bulk lot.** An indefinite quantity of a homogeneous mixture of materials offered for acceptance in a single isolated container.

**6.3.2 Clear and bright.** The terms clear and bright are independent of the natural color of the fuel. Clear means the absence of any cloud, emulsion, or readily visible particulate matter or free water. Bright refers to the shiny appearance of clean, dry fuel.

**6.3.3 Conventional source blending component.** Blending streams derived from the following conventional sources: crude oil, petroleum, oil sands, oil shale, natural gas liquid condensates, or mixtures thereof.

**6.3.4 Fatty acid methyl ester (FAME).** Synonymous with biodiesel meeting the requirements of ASTM D6751 or BS EN 14214. According to ASTM D6751, "biodiesel is a fuel comprised of fatty acids derived from vegetable oils or animal fats, designated B100." The recent introduction of FAME in the commercial middle distillate marketplace has resulted in the potential for trace amounts of FAME in F-76 fuel.

**6.3.5 Finished fuel.** Fuel conforming to the requirements of section 3 and containing a maximum of 50 volume percent SPDs or a maximum of 20 volume percent SIP materials.

**6.3.6 Fischer-Tropsch hydroprocessed synthesized paraffinic diesel (FT-SPD).** SPD synthesized by FT processing. FT-SPD may also be referred to as paraffinic middle distillate (PMD).

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6.3.7 Hydroprocessed. Conventional chemical processing in which hydrogen is reacted with organic compounds in the presence of a catalyst to remove impurities such as oxygen, sulfur, nitrogen; to saturate unsaturated hydrocarbons; or to alter the molecular structure of the hydrocarbon molecules.

6.3.8 Hydroprocessed fermented sugars. Farnesane that is produced by hydroprocessing and fractionation of farnesene derived from the fermentation of sugars.

6.3.9 Hydroprocessed or hydrotreated renewable diesel (HRD). SPD produced from mono-, di-, and triglycerides, free fatty acids, and fatty acid esters from plant, algal oils, or animal fats (for example, FAME) that have been hydroprocessed to remove essentially all oxygen. HRD may also be referred to as hydroprocessed esters and fatty acids synthesized paraffinic diesel (HEFA-SPD) or PMD.

6.3.10 Packaged lot. An indefinite number of 208-liter (55-gallon) drums or smaller unit containers of identical size and type, offered for acceptance, and filled with a homogeneous mixture of material from one isolated container; or filled with a homogeneous mixture of material manufactured in a single plant run (not exceeding 24 hours) through the same processing equipment, with no change in ingredient material.

6.3.11 Synthesized iso-paraffins (SIP). A middle distillate blending component consisting of nearly all iso-paraffins that meet the requirements of Appendix B.

6.3.12 Synthesized paraffinic diesel (SPD). A middle distillate blending component consisting of n-paraffins, iso-paraffins, and cycloparaffins that meet the requirements of Appendix A. Hydrocarbons are derived from alternative sources such as coal, natural gas, biomass, and hydrogenated fats and oils by processes such as FT synthesis and hydroprocessing.

6.4 NAVSEA approval and direction. Deviation from specified materials, procedures, and requirements, and selection of specific alternative materials and procedures requires NAVSEA approval or direction. Requests should include supporting documentation.

6.5 Recommended examination lot acceptance/rejection criteria. If, as a result of the examination of the packaged lot, the number of defective or under-filled containers exceeds the reject limit number of table III, the lot represented by the sample should be rejected as specified (see 6.2).

TABLE III. Lot acceptance/rejection criteria.

Lot Size	Sample Size	Reject Limit
1-13	All	Any
14-150	13	1
151-250	32	2
251-500	50	3
501-1,200	80	4
1,201-3,200	125	6
3,201-10,000	200	11
10,001-35,000	315	15
35,001 and over	500	22

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TABLE III. Lot acceptance/rejection criteria – Continued.

## NOTES:

1. All defective items should be replaced with acceptable items prior to lot acceptance.
2. Inspect sample size until reject criteria are reached.
3. Rejected lots may be screened and resubmitted for inspection and retest.

6.6 Toxicity evaluation. The NMCPHC requires sufficient information to permit an HHA of the product. Upon completion of the HHA, a copy will be provided by the NMCPHC to the Government for evaluation. The HHA process is described on the NMCPHC's website, <http://www.med.navy.mil/sites/nmcphc/industrial-hygiene/Pages/health-hazard-assessment.aspx>.

6.7 Subject term (key word) listing.

Boiler  
 Diesel  
 Diesel engine  
 Fischer-Trosch Hydroprocessed Synthetic Paraffinic Diesel  
 FT-SPD  
 Gas turbine engine  
 HEFA  
 HRD  
 Hydroprocessed Esters and Fatty Acids  
 Hydroprocessed Renewable Diesel  
 Hydrotreated Renewable Diesel  
 Lubricity  
 Marine diesel  
 Marine gas oil  
 Metal deactivator  
 Oil  
 Paraffinic middle  
 Refined hydrocarbon  
 SPD  
 Synthesized Paraffinic Diesel

6.8 International standardization agreement implementation. This specification implements NATO STANAG 1135, Interchangeability of Fuels, Lubricants and Associated Products Used by the Armed Forces of the North Atlantic Treaty Nations, and NATO STANAG 1385, Guide Specification for Naval Distillate Fuels (F-75 and F-76). When amendment, revision, or cancellation of this specification is proposed, the preparing activity must coordinate the action with the U.S. National Point of Contact for the international standardization agreement, as identified in the ASSIST database at <https://assist.dla.mil>.

6.9 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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APPENDIX A

## HYDROPROCESSED SYNTHESIZED PARAFFINIC DIESEL (SPD)

## A.1 SCOPE

A.1.1 Scope. This appendix defines hydroprocessed SPD for use as a synthetic blending component in naval distillate fuels. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

## A.2 APPLICABLE DOCUMENTS

A.2.1 General. The documents listed in this section are specified in Appendix A of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in Appendix A of this specification, whether or not they are listed.

A.2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

## ASTM INTERNATIONAL

- ASTM D86 - Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure
- ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- ASTM D130 - Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- ASTM D189 - Standard Test Method for Conradson Carbon Residue of Petroleum Products
- ASTM D287 - Standard Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)
- ASTM D445 - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- ASTM D524 - Standard Test Method for Ramsbottom Carbon Residue of Petroleum Products
- ASTM D664 - Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration
- ASTM D613 - Standard Test Method for Cetane Number of Diesel Fuel Oil
- ASTM D974 - Standard Test Method for Acid and Base Number by Color-Indicator Titration
- ASTM D1298 - Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- ASTM D2425 - Standard Test Method for Hydrocarbon Types in Middle Distillates by Mass Spectrometry
- ASTM D2500 - Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels
- ASTM D2622 - Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry
- ASTM D3241 - Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels

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- ASTM D3828 - Standard Test Methods for Flash Point by Small Scale Closed Cup Tester
- ASTM D4052 - Standard Test Method for Density, Relative Density and API Gravity of Liquids by Digital Density Meter
- ASTM D4530 - Standard Test Method for Determination of Carbon Residue (Micro Method)
- ASTM D4629 - Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection
- ASTM D4808 - Standard Test Methods for Hydrogen Content of Light Distillates, Middle Distillates, Gas Oils, and Residua by Low-Resolution Nuclear Magnetic Resonance Spectroscopy
- ASTM D4809 - Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)
- ASTM D5291 - Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants
- ASTM D5452 - Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
- ASTM D5453 - Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
- ASTM D5771 - Standard Test Method for Cloud Point of Petroleum Products (Optical Detection Stepped Cooling Method)
- ASTM D5772 - Standard Test Method for Cloud Point of Petroleum Products (Linear Cooling Rate Method)
- ASTM D5773 - Standard Test Method for Cloud Point of Petroleum Products (Constant Cooling Rate Method)
- ASTM D6217 - Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration
- ASTM D6304 - Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration
- ASTM D6890 - Standard Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber
- ASTM D7042 - Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)
- ASTM D7111 - Standard Test Method for Determination of Trace Elements in Middle Distillate Fuels by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)
- ASTM D7170 - Standard Test Method for Determination of Derived Cetane Number (DCN) of Diesel Fuel Oils—Fixed Range Injection Period, Constant Volume Combustion Chamber Method
- ASTM D7171 - Standard Test Method for Hydrogen Content of Middle Distillate Petroleum Products by Low-Resolution Pulsed Nuclear Magnetic Resonance Spectroscopy

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ASTM D7261 - Standard Test Method for Determining Water Separation Characteristics of Diesel Fuels by Portable Separometer

(Copies of these documents are available online at <http://www.astm.org>.)

## A.3 MATERIALS AND MANUFACTURE

A.3.1 SPDs. SPDs shall be derived from FT or HRD methods. FT-SPD blending components shall be wholly derived from synthesis gas via the FT process using iron or cobalt catalyst. HRD blend components shall be comprised of hydrocarbon fuel obtained from hydrogenation and deoxygenation of fatty acid esters and free fatty acids. Subsequent processing of the product shall include hydrotreating, hydrocracking, or hydroisomerization and is expected to include, but not be limited to, a combination of other conventional refinery processes such as polymerization, isomerization, and fractionation.

## A.4 DETAILED BATCH REQUIREMENTS

A.4.1 Batch requirements. Each batch of synthesized blending component shall conform to the requirements prescribed in [table A-I](#).

A.4.2 Hydroprocessed SPD batch. The hydroprocessed SPD blend component shall meet the requirements of [table A-I](#). It is not necessary to analyze each batch of hydroprocessed SPD for compliance with [table A-II](#) once it is demonstrated that the process scheme is adequately controlled to support the expectation that these requirements are always met. At a minimum, batches shall be required to meet the specifications of [table A-II](#) when new production facilities or schemes are established, or when significant changes to existing production operations are implemented, such as the introduction of a new feedstock material.

TABLE A-I. Detailed batch requirements: hydroprocessed SPD.

Characteristic	Requirement		ASTM Method
	Minimum	Maximum	
Acid Number, mg KOH/g		0.08	ASTM D974 (R), ASTM D664
Carbon Residue on 10% bottoms, mass %		0.20	ASTM D524 (R) <sup>1/</sup>
		0.14	ASTM D189 <sup>1/</sup> , ASTM D4530 <sup>1/</sup>
Cloud Point, °C		-1	ASTM D2500 (R), ASTM D5771, ASTM D5772, ASTM D5773
Corrosion, 2 hours at 100 °C		No. 1	ASTM D130
Density, at 15 °C, kg/m <sup>3</sup>	770.0	805.0	ASTM D1298 (R), ASTM D4052, ASTM D287
Cetane Number, or Derived Cetane Number	42 42.0	80 80.0	ASTM D613 (R) ASTM D6890, ASTM D7170

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TABLE A-I. Detailed batch requirements; hydroprocessed SPD – Continued.

<b>Characteristic</b>	<b>Requirement</b>		<b>ASTM Method</b>
	<b>Minimum</b>	<b>Maximum</b>	
Distillation:			
Initial Boiling Point, °C	Record		ASTM D86
10% Recovered, °C	191.0	290.0	
50% Recovered, °C	Record		
90% Recovered, °C	290.0	357.0	
Final Boiling Point, °C	300.0	385.0	
T50-T10, °C	Record		
T90-T10, °C	20.0		
Residue + Loss, volume %		3.0	
Flash Point, °C	60.0		ASTM D93 (R) <sup>2/</sup> , ASTM D3828
Heating Value, MJ/kg	43.5		ASTM D4809
Hydrogen Content, mass %	14.50		ASTM D7171 (R), ASTM D4808, ASTM D5291
Kinematic Viscosity, at 40 °C, mm <sup>2</sup> /s	1.700	4.300	ASTM D445, ASTM D7042
Diesel Microseparometer (DSEP)	85		ASTM D7261
Particulate Contamination, mg/L		1.0	ASTM D6217 (R), ASTM D5452
Thermal Stability:			ASTM D3241 <sup>3/</sup>
Change in Pressure Drop, mm of Hg and		25	
Tube Deposit Code, less than or		3 <sup>4/</sup>	
Average Deposit Thickness, nm, over area of 2.5 mm <sup>2</sup>		85	
Total Water, mg/kg		100	ASTM D6304
FOOTNOTES:			
<sup>1/</sup>	Fuel shall meet the requirements for one of the three test methods. If ASTM D189 or ASTM D4530 is performed in lieu of the referee test method, ASTM D524, the maximum allowable carbon residue shall be 0.14 mass percent.		
<sup>2/</sup>	ASTM D3828 may give results up to 1.7 °C below the ASTM D93 results.		
<sup>3/</sup>	See A.4.5.1 and A.4.5.2 for ASTM D3241 test conditions and procedures.		
<sup>4/</sup>	If the visual rating of the heater tube shows Peacock (P) or Abnormal (A) type deposits, the fuel sample is not acceptable.		
NOTE:	Table A-I identifies the referee test method first, followed by the notation "(R)." "(R)" denotes the referee test method.		

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TABLE A-II. Other detailed requirements; hydroprocessed SPD.

<b>Characteristic</b>	<b>Requirement</b>		<b>ASTM Method</b>
	<b>Minimum</b>	<b>Maximum</b>	
<b>Hydrocarbon Composition</b>			
Cycloparaffins, mass %		15 <sup>1/</sup>	ASTM D2425
Aromatics, mass %		0.5	ASTM D2425
Paraffins (normal and iso), mass %	Record		ASTM D2425
Carbon and Hydrogen, mass %	99.5		ASTM D5291
<b>Non-Hydrocarbon Composition</b>			
Nitrogen, mg/kg		10	ASTM D4629
Sulfur, mg/kg		15	ASTM D5453 (R), ASTM D2622
Metals <sup>2/</sup> (Al, Ca, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, P, Pb, Pd, Pt, Sn, Sr, Ti, V, Zn), mg/kg		0.10 per metal	ASTM D7111
Alkali Metals and Metalloids <sup>2/</sup> (B, Na, K, Si, Li), mg/kg		1.00 total	ASTM D7111
FOOTNOTES:			
<sup>1/</sup> Maximum cycloparaffin composition is based on current experience with the approved synthetic fuels and is within the range of what is typical for refined diesel fuel.			
<sup>2/</sup> All detected metals below the detection limits shall be considered as 0 µg/kg. Only the metals with measured values higher than their respective detection limits shall be considered as legitimate values for calculation.			
NOTE: Table A-II identifies the referee test method first, followed by the notation "(R)." "(R)" denotes the referee test method.			

**A.4.3 Fuel additives.** When specified (see 6.2), information concerning the name and dosage rate of each additive used shall be made available.

**A.4.4 Antioxidants.** Antioxidant shall be added as soon as practicable after hydroprocessing or fractionation synthesizing and prior to the product or component being passed into storage to prevent peroxidation and gum formation after manufacture. Not less than 17.2 mg/L or more than 24.0 mg/L of active ingredient shall be used. The following antioxidant formulations are approved:

- a. 2,6-di-tert-butyl-4-methylphenol
- b. 6-tert-butyl-2,4-dimethylphenol
- c. 2,6-di-tert-butylphenol
- d. 75 percent minimum 2,6-di-tert-butylphenol  
25 percent maximum tert-butylphenols and tri-tert-butylphenols
- e. 72 percent minimum 6-tert-butyl-2,4-dimethylphenol  
28 percent maximum tert-butyl-methylphenols and tert-butyl-dimethylphenols
- f. 55 percent minimum 2,4-dimethyl-6-tert-butylphenol and  
15 percent minimum 2,6-di-tert-butyl-4-methylphenol and  
30 percent maximum mixed methyl and dimethyl tert-butylphenols

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A.4.5 Thermal stability. The thermal stability test shall be conducted using ASTM D3241 (Thermal Oxidation Stability of Aviation Fuels Test). The heater tube shall be rated visually (see ASTM D3241, Heater Tubes Annex, Test Method for Visual Rating).

A.4.5.1 Test conditions. The following test conditions shall apply:

- a. Minimum heater tube temperature at maximum point: 325 °C
- b. Fuel system pressure: 3.45 MPa (500 psig)
- c. Fuel flow rate: 3.0 mL/minute
- d. Test duration: 150 minutes

A.4.5.2 ASTM D3241 procedure.

- a. The differential pressure in mm Hg at 150 minutes or time to differential pressure of 25 mm Hg, whichever comes first, shall be recorded.
- b. The heater tube deposit code rating shall be recorded at the end of the test.

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APPENDIX B

## SYNTHESIZED ISO-PARAFFINS (SIP) FROM HYDROPROCESSED FERMENTED SUGARS

## B.1 SCOPE

B.1.1 Scope. This appendix defines SIP produced from hydroprocessed fermented sugars for use as a synthetic blending component in marine diesel fuels. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

## B.2 APPLICABLE DOCUMENTS

B.2.1 General. The documents listed in this section are specified in Appendix B of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in Appendix B of this specification, whether or not they are listed.

B.2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

## ASTM INTERNATIONAL

- ASTM D86 - Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure
- ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- ASTM D287 - Standard Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)
- ASTM D381 - Standard Test Method for Gum Content in Fuels by Jet Evaporation
- ASTM D613 - Standard Test Method for Cetane Number of Diesel Fuel Oil
- ASTM D664 - Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration
- ASTM D974 - Standard Test Method for Acid and Base Number by Color-Indicator Titration
- ASTM D1298 - Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- ASTM D2425 - Standard Test Method for Hydrocarbon Types in Middle Distillates by Mass Spectrometry
- ASTM D2500 - Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels
- ASTM D2622 - Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry
- ASTM D2710 - Standard Test Method for Total Fluorine, Chlorine, and Sulfur in Aromatic Hydrocarbons and Their Mixtures by Oxidative Pyrohydrolytic Combustion followed by Ion Chromatography Detection (Combustion Ion Chromatography-CIC)
- ASTM D3241 - Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels
- ASTM D3828 - Standard Test Methods for Flash Point by Small Scale Closed Cup Tester

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- ASTM D4052 - Standard Test Method for Density, Relative Density and API Gravity of Liquids by Digital Density Meter
- ASTM D4629 - Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection
- ASTM D4809 - Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)
- ASTM D5291 - Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants
- ASTM D5452 - Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
- ASTM D5453 - Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
- ASTM D5771 - Standard Test Method for Cloud Point of Petroleum Products (Optical Detection Stepped Cooling Method)
- ASTM D5772 - Standard Test Method for Cloud Point of Petroleum Products (Linear Cooling Rate Method)
- ASTM D5773 - Standard Test Method for Cloud Point of Petroleum Products (Constant Cooling Rate Method)
- ASTM D6217 - Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration
- ASTM D6304 - Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration
- ASTM D6890 - Standard Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber
- ASTM D7111 - Standard Test Method for Determination of Trace Elements in Middle Distillate Fuels by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)
- ASTM D7170 - Standard Test Method for Determination of Derived Cetane Number (DCN) of Diesel Fuel Oils—Fixed Range Injection Period, Constant Volume Combustion Chamber Method
- ASTM D7261 - Standard Test Method for Determining Water Separation Characteristics of Diesel Fuels by Portable Separometer
- ASTM D7359 - Standard Test Method for Total Fluorine, Chlorine and Sulfur in Aromatic Hydrocarbons and Their Mixtures by Oxidative Pyrohydrolytic Combustion followed by Ion Chromatography Detection (Combustion Ion Chromatography-CIC)
- ASTM D7974 - Standard Test Method for Determination of Farnesane, Saturated Hydrocarbons, and Hexahydrofarnesol Content of Synthesized Iso-Paraffins (SIP) Fuel for Blending with Jet Fuel by Gas Chromatography

(Copies of these documents are available online at <http://www.astm.org>.)

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MIL-DTL-16884P  
APPENDIX B

## B.3 MATERIALS AND MANUFACTURE

B.3.1 SIP. SIP shall be derived from farnesene produced from fermentable sugars. Subsequent processing of farnesene into iso-paraffins shall include a combination of hydroprocessing and fractionation operations, and may include other conventional refinery processes. In particular, hydroprocessing operations consist of reacting hydrogen with farnesene feedstock and fractionation operations consist of gas/liquid separation and isolation of SIP. For example, fractionation typically includes a distillation step.

## B.4 DETAILED BATCH REQUIREMENTS

B.4.1 Batch requirements. Each batch of synthetic blending component shall conform to the requirements prescribed in table B-I.

B.4.2 SIP batch. The SIP blend component shall meet the requirements of table B-I. It is not necessary to analyze each batch of SIP for compliance with table B-II once it is demonstrated that the process scheme is adequately controlled to support the expectation that these requirements are always met. At a minimum, batches shall be required to meet the specifications of table B-II when new production facilities or schemes are established, or when significant changes to existing production operations are implemented, such as the introduction of a new feedstock material.

TABLE B-I. Detailed batch requirements; SIP.

Characteristic	Requirement		ASTM Method
	Minimum	Maximum	
Acid Number, mg KOH/g		0.015	ASTM D974 (R), ASTM D664
Cloud Point, °C		-70	ASTM D2500 (R), ASTM D5771, ASTM D5772, ASTM D5773
Density, at 15 °C, kg/m <sup>3</sup>	765.0	780.0	ASTM D1298 (R), ASTM D4052, ASTM D287
Cetane Number, or Derived Cetane Number	42 42.0	80 80.0	ASTM D613 (R) ASTM D6890, ASTM D7170
Distillation:			ASTM D86
Initial Boiling Point, °C	Record	250.0	
10% Recovered, °C			
50% Recovered, °C	Record	255.0	
90% Recovered, °C	Record	5.0	
Final Boiling Point, °C		3.0	
T90-T10, °C			
Residue + Loss, volume %			
Diesel Microseparometer (DSEP)	85		ASTM D7261
Existent Gum, mg/100mL		7	ASTM D381
Flash Point, °C	100.0		ASTM D93 (R) <sup>1/</sup> , ASTM D3828
Heating Value, MJ/kg	43.5		ASTM D4809
Hexahydrofarnesol, mass %		1.5	ASTM D7974
Particulate Contamination, mg/L		1.0	ASTM D6217 (R), ASTM D5452

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MIL-DTL-16884P  
APPENDIX BTABLE B-I. Detailed batch requirements; SIP – Continued.

Characteristic	Requirement		ASTM Method
	Minimum	Maximum	
Thermal Stability: Change in Pressure Drop, mm of Hg and Tube Deposit Code, less than or Average Deposit Thickness, nm, over area of 2.5 mm <sup>2</sup>		25 3 <sup>3/</sup> 85	ASTM D3241 <sup>2/</sup>
Total Water, mg/kg		75	ASTM D6304
FOOTNOTES:			
<sup>1/</sup> ASTM D3828 may give results up to 1.7 °C below the ASTM D93 results.			
<sup>2/</sup> See B.4.5.1 and B.4.5.2 for ASTM D3241 test conditions and procedures.			
<sup>3/</sup> If the visual rating of the heater tube shows Peacock (P) or Abnormal (A) type deposits, the fuel sample is not acceptable.			
NOTE: Table B-I identifies the referee test method first, followed by the notation “(R).” “(R)” denotes the referee test method.			

TABLE B-II. Other detailed requirements; SIP.

Characteristic	Requirement		ASTM Method
	Minimum	Maximum	
<b>Hydrocarbon Composition</b>			
Saturated Hydrocarbons, mass %	98		ASTM D7974
Farnesane, mass %	97		ASTM D7974
Olefins, mgBr <sub>2</sub> /100 g		300	ASTM D2710
Aromatics, mass %		0.5	ASTM D2425
Carbon and Hydrogen, mass %	99.5		ASTM D5291
<b>Non-Hydrocarbon Composition</b>			
Nitrogen, mg/kg		2	ASTM D4629
Sulfur, mg/kg		2	ASTM D5453 (R), ASTM D2622
Metals <sup>1/</sup> (Al, Ca, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Pd, Pt, Sn, Sr, Ti, V, Zn), mg/kg		0.10 per metal	ASTM D7111
Halogens, mg/kg		1 per halogen	ASTM D7359
FOOTNOTE:			
<sup>1/</sup> All detected metals below the detection limits shall be considered as 0 µg/kg. Only the metals with measured values higher than their respective detection limits shall be considered as legitimate values for calculation.			
NOTE: Table B-II identifies the referee test method first, followed by the notation “(R).” “(R)” denotes the referee test method.			

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APPENDIX B

B.4.3 Fuel additives. When specified (see 6.2), information concerning the name and dosage rate of each additive used shall be made available.

B.4.4 Antioxidants. Antioxidant shall be added as soon as practicable after hydroprocessing or fractionation synthesizing and prior to the product or component being passed into storage to prevent peroxidation and gum formation after manufacture. Not less than 17.2 mg/L or more than 24.0 mg/L of active ingredient shall be used. The following antioxidant formulations are approved:

- a. 2,6-di-tert-butyl-4-methylphenol
- b. 6-tert-butyl-2,4-dimethylphenol
- c. 2,6-di-tert-butylphenol
- d. 75 percent minimum 2,6-di-tert-butylphenol  
25 percent maximum tert-butylphenols and tri-tert-butylphenols
- e. 72 percent minimum 6-tert-butyl-2,4-dimethylphenol  
28 percent maximum tert-butyl-methylphenols and tert-butyl-dimethylphenols
- f. 55 percent minimum 2,4-dimethyl-6-tert-butylphenol and  
15 percent minimum 2,6-di-tert-butyl-4-methylphenol and  
30 percent maximum mixed methyl and dimethyl tert-butylphenols

B.4.5 Thermal stability. The thermal stability test shall be conducted using ASTM D3241 (Thermal Oxidation Stability of Aviation Fuels Test). The heater tube shall be rated visually (see ASTM D3241, Heater Tubes Annex, Test Method for Visual Rating).

B.4.5.1 Test conditions. The following test conditions shall apply:

- a. Minimum heater tube temperature at maximum point: 325 °C
- b. Fuel system pressure: 3.45 MPa (500 psig)
- c. Fuel flow rate: 3.0 mL/minute
- d. Test duration: 150 minutes

B.4.5.2 ASTM D3241 procedure.

- a. The differential pressure in mm Hg at 150 minutes or time to differential pressure of 25 mm Hg, whichever comes first, shall be recorded.
- b. The heater tube deposit code rating shall be recorded at the end of the test.

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CONCLUDING MATERIAL

Custodians:

Army – CR4  
Navy – SH  
Air Force – 68  
DLA – PS

Preparing activity:

Navy – SH  
(Project 9140-2017-001)

Review activities:

Army – AT  
Navy – CG, MC, SA  
DLA – GS

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.

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# EXHIBIT 44

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METRIC

MIL-DTL-85470B  
15 June 1999  
SUPERSEDING  
MIL-I-85470A  
8 August 1990

DETAIL SPECIFICATION

INHIBITOR, ICING, FUEL SYSTEM, HIGH FLASH  
NATO CODE NUMBER S-1745

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for one type and grade of a high flash, fuel system icing inhibitor soluble in aircraft turbine engine fuel. This inhibitor is primarily composed of diethylene glycol monomethyl ether and is commonly referred to as DiEGME.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommend for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Naval Air Systems Command, Fuels and Lubricants Division, AIR-4.4.5, Bldg. 2360, PSEF Building 22229 Elmer Road, Unit 4, Patuxent River, MD 20670-1534, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 6850

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

**MIL-DTL-85470B**

**2.2.1 Standards.** The following standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

**STANDARDS****FEDERAL**

FED-STD-791 - Lubricant, Liquid Fuel and Related Products, Methods of Testing

(Unless otherwise indicated, copies of the above standards are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

**2.3 Non-Government publications.** The following documents form a part of this document to the extent cited herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

ASTM-D56 - Flash Point by Tag Closed Tester (DoD adopted), Standard Test Method for

ASTM-D93 - Flash Point by Pensky Martens Closed Tester (DoD adopted), Standard Test Method for

ASTM-D891 - Specific Gravity, Apparent, of Liquid Industrial Chemicals, Standard Test Method for

ASTM-D1078 - Distillation Range of Volatile Organic Liquids (DoD adopted), Standard Test Method for

ASTM-D1209 - Color of Clear Liquids (Platinum-Colbalt Scale) (DoD adopted), Standard Test Method for

ASTM-D1364 - Water in Volatile Solvents (Fischer Reagent Titration Method) (DoD adopted), Standard Test Method for

ASTM-D1613 - Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer, and Related Products (DoD adopted), Standard Test Method for

ASTM-D3828 - Flash Point by Setaflash Closed Tester (DoD adopted), Standard Test Method for

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ASTM-D4052	- Density of Liquids by Digital Density Meter (DoD adopted), Standard Test Method for
ASTM-D4171	- Fuel System Icing Inhibitors, Standard Specification for
ASTM-E29	- Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (DoD adopted)
ASTM-E70	- pH of Aqueous Solutions with the Glass Electrode (DoD adopted), Standard Test Method for
ASTM-E203	- Water Using Karl Fischer Reagent (DoD adopted), Standard Test Method for
ASTM-E300	- Sampling Industrial Chemicals, Standard Practice for
ASTM-E450	- Measurement of Color of Low-Colored Clear Liquids Using Hunterlab Color Difference Meter, Standard Test Method for

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

**2.4 Order of precedence.** In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specified exemption has been obtained.

### 3. REQUIREMENTS

**3.1 Materials.** The inhibitor shall be composed entirely of diethylene glycol monomethyl ether except that an antioxidant specified in 3.2 shall be added at a concentration from 50 to 150 parts per million by weight. The antioxidant shall be added immediately after processing and before the inhibitor is exposed to the atmosphere. The inhibitor shall conform to the requirements of table I when tested in accordance with section 4.

**3.2 Antioxidants.** The antioxidant added to the inhibitor shall be one of the following:

- a. 2,6 ditertiary butyl, 4-methylphenol
- b. 2,4 dimethyl, 6-tertiary butylphenol
- c. 2,6 ditertiary butylphenol
- d. Mixed tertiary butylphenol composition:  
75 percent, minimum, 2,6 ditertiary butylphenol  
25 percent, maximum, tertiary and tritertiary butylphenols

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TABLE I. Properties of the inhibitor and test methods.

Property	Limit	Test Method
Acid number, mg KOH per gram (maximum)	0.09	ASTM-D1613
Color, platinum cobalt (maximum)	10	ASTM-D1209 <sup>1/</sup> or ASTM-E450
Distillation: Initial point, minimum Dry point, maximum	191.0 198.0	ASTM-D1078
Ethylene glycol (maximum, percent by weight)	0.5	<sup>2/</sup>
pH of 25 percent solution in water (25+/- 2°C)	5.5 to 7.5	ASTM-E70 <sup>3/</sup>
Relative density (20/20 °C)	1.021 to 1.025	ASTM-D891 <sup>1/4/</sup> or ASTM-D4052
Water (maximum, mass %)	0.1	ASTM-D1364 <sup>1/</sup> , ASTM-E1064 or ASTM-E203
Flash point, °C (°F) (minimum)	85 (185)	ASTM-D93 <sup>1/</sup> , ASTM-D56, or ASTM-D3828

Notes: 1/ Referee Test Method

2/ See 4.7.1.1

3/ See 4.7.1.2

4/ ASTM-D891 Method A or B

3.3 Workmanship. The inhibitor shall be uniform in quality, clear and bright, and free from suspended and foreign matter (see 4.5.1).

3.4 Precautionary markings. The following precautionary marking shall be included on containers of this product:

**"TO BE USED ONLY AS AN ANTI-ICING ADDITIVE  
FOR AIRCRAFT TURBINE ENGINE FUELS"**

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#### 4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as conformance inspection.

##### 4.2 Inspection lot.

4.2.1 Bulk lot. A bulk lot shall consist of an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single isolated container; or manufactured by a single plant run (not exceeding 24 hours) through the same processing equipment, with no change in ingredient material.

4.2.2 Packaged lot. A packaged lot shall consist of an indefinite number of 208 liter (55 gallon) drums or smaller unit packages of identical size and type, offered for acceptance, and filled with an homogeneous mixture from one isolated container, or filled with an homogeneous mixture of material manufactured by a single plant run (not exceeding 24 hours) through the same processing equipment, with no change in ingredient material.

4.3 Inspection. Inspection shall be in accordance with FED-STD-791, Method 9601.

4.3.1 Inspection conditions. Requirements contained in table I are absolute, as defined in ASTM-E29, and shall not be subject to correction for test tolerances. If multiple determinations are made, results falling within any specified repeatability and reproducibility tolerance may be averaged. For rounding off of significant figures, ASTM-E29 shall apply to all tests required by this specification.

##### 4.4 Sampling.

4.4.1 Sampling of inhibitor. Each bulk or packaged lot shall be sampled in accordance with ASTM-E300. The samples shall be subjected to the examination of inhibitor specified in 4.5.1 and tested per 4.7.

4.4.2 Sampling for inspection of filled containers. A random sample of filled containers shall be selected from each lot. The sample containers shall be subjected to the examination of filled containers as specified in 4.5.2.

##### 4.5 Examinations.

4.5.1 Examination of inhibitor. Samples selected in accordance with 4.4.1 shall be visually examined for compliance with 3.3.

4.5.2 Examination of filled containers. Each container selected shall be examined for defects of the container and closure, for evidence of leakage, for markings specified in 3.4 and all other

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packaging requirements. Each filled container shall also be weighed to determine the amount of contents. Any container in the sample having one or more defects or under the required fill shall be rejected.

**4.5.3 Examination of empty containers.** Containers shall not contain any foreign material such as solids, corrosion products, water, or other sediments. Container seams shall be inspected for evidence of metal corrosion, flux, solder and such materials as would contaminate the product. Any container not meeting these criteria shall be rejected.

**4.6 Rejection.** Failure of any sample of the inhibitor to conform to any one of the requirements to this specification shall be cause for rejection of the lot represented.

**4.7 Test methods.**

**4.7.1 Inhibitor properties.** The inhibitor properties shall be tested in accordance with the ASTM test methods listed in table I and as specified in 4.7.1.1 through 4.7.1.2.

**4.7.1.1 Ethylene glycol (percent by weight).** The percent of ethylene glycol component in the diethylene glycol monomethyl ether shall be determined as specified in subparagraphs 4.7.1.1.1, 4.7.1.1.2, and 4.7.1.1.3 (titration method) or ASTM-D4171 Annex A1 Test Method for Determining Purity of Fuel System Icing Inhibitors Using Ultra High Purity Ethylene Glycol Monomethyl Ether (anhydrous, 99.5+%) as the calibration standard for the analysis of diethylene glycol monomethyl ether.

**4.7.1.1.1 Reagents and materials.** Unless otherwise indicated, all reagents shall be American Chemical Society reagent grade or equivalent. Reference to water indicates distilled or deionized water. The following materials shall be prepared:

a. Oxidizing reagents: To a solution containing 5 grams of periodic acid ( $\text{HIO}_4$ ) or 5.9 grams of paraperiodic acid ( $\text{HIO}_4 \bullet 2\text{H}_2\text{O}$ ) in 200 milliliters (ml) of water, add 800 ml of glacial acetic acid. Store the solution in a dark, well-stoppered bottle.

b. Potassium iodide: Twenty percent aqueous solution. Weigh out 20 grams of potassium iodide and dilute to 100 ml with distilled water.

c. Sodium thiosulfate, standard 0.2N: Standardize weekly or before using by an accepted procedure.

d. Starch indicator solution: One percent aqueous.

**4.7.1.1.2 Procedure.** The following procedure shall be performed:

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- a. Pipette 100 ml of the oxidizing reagent into each of four 500 ml iodine flasks. Reserve two of the flasks for the blank determination.
- b. Introduce 15 grams of the sample, weighed to the nearest 0.1 gram, into each of two flasks and swirl to effect solution.
- c. Allow the flasks to stand for 30 minutes at room temperature.
- d. While swirling, add 20 ml of 20 percent potassium iodide solution to each flask, in turn, immediately before titrating.
- e. Titrate the contents of each flask to a pale yellow color with standard 0.2N sodium thiosulfate. Add 2 ml of starch indicator and titrate to the disappearance of the blue color.
- f. If the net titration is more than 20 ml, repeat the determination, using a smaller sample size.

4.7.1.1.3 Calculations. Calculate the concentration of ethylene glycol as:

$$\text{Weight percent ethylene glycol} = \frac{(B-A) \times N \times 3.103}{s}$$

Where: A = ml of sodium thiosulfate required for the sample.

B = average ml of sodium thiosulfate required for the blank.

N = normality of sodium thiosulfate.

s = grams of sample.

4.7.1.2 pH of 25 percent solution in water. Twenty-five ml of the inhibitor shall be pipetted into a 100 ml volumetric flask and filled with freshly boiled and cooled distilled water having a pH of 6.5 to 7.5. The pH value shall be measured with a pH meter calibrated in accordance with ASTM-E70. To avoid error caused by carbon dioxide in the air, the gas space over the solution shall be purged with carbon dioxide-free air.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military

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Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that is helpful, but not mandatory.)

6.1 Intended use. The inhibitor is intended for use as an anti-icing agent to be added to military aircraft turbine engine fuels. The requirements defining the product covered by this specification are needed for the unique operating environment of military aircraft and are not identical to similar commercial specifications. Products defined by commercial specifications with the same chemical name are only acceptable for use in military equipment if they meet all of the requirements of this specification. The military is the only entity actively pursuing the development of environmentally friendly anti-icing agents. This specification will be used as a platform to define the requirements of future environmentally friendly anti-icing agents.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. FSII - DiEGME.
- c. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
- d. Quantity desired.
- e. Special markings (see 3.4).
- f. Packaging requirements (see 5.1).

6.2.1 Unit of purchase. Unit of purchase is 3.8 liters (U.S. gallon of 231 cubic inches) at 15.5 °C (60 °F). When weight is used as the basis for quantity determination, table II should be used to determine the quantity in liters at 15 °C, or gallons at 60 °F.

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TABLE II. Conversion factors - weight to liters at 15 °C (or gallons at 60 °F).

If the specific gravity at 20/20 °C is:	To obtain liters at 15 °C, divide kilograms by:	To obtain gallons at 60 °F, divide pounds by:	To obtain gallons at 60 °F, divide kilograms by:
1.020	1.023 kg/L	8.530 lb/gal	3.869 kg/gal
1.021	1.024	8.539	3.873
1.022	1.025	8.547	3.877
1.023	1.026	8.546	3.881
1.024	1.027	8.564	3.885
1.025	1.028	8.572	3.888

6.3 International standardization. Certain provisions of this specification are the subject of international standardization agreements ASCC Air Std 15/1 and STANAG 1135. When amendment, revision, or cancellation of this specification is proposed which will affect or violate the international agreement concerned, the preparing activity will take appropriate reconciliation action through international standardization channels including departmental standardization offices, if required.

6.4 Warning. Undiluted diethylene glycol monomethyl ether (DiEGME) is combustible. Before handling DiEGME, consult appropriate safety and occupational health directives and Material Safety Data Sheets.

#### 6.5 Subject term (key word) listing.

FSII

Diethylene glycol monomethyl ether

DiEGME

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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CONCLUDING MATERIAL

Custodians:

Army - CR4  
Air Force - 11  
Navy - AS

Preparing activity:

Navy - AS

(Project No. 6850-1426)

Review activities:

Army - AV  
Air Force - 68  
DLA - PS

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL**INSTRUCTIONS**

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

**NOTE:** This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

<b>I RECOMMEND A CHANGE:</b>														
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; padding: 2px;">1. DOCUMENT NUMBER MIL-DTL-85470B</td> <td style="width: 33%; padding: 2px;">2. DOCUMENT DATE (YYYYMMDD) 99/06/15</td> </tr> </table>			1. DOCUMENT NUMBER MIL-DTL-85470B	2. DOCUMENT DATE (YYYYMMDD) 99/06/15										
1. DOCUMENT NUMBER MIL-DTL-85470B	2. DOCUMENT DATE (YYYYMMDD) 99/06/15													
<b>3. DOCUMENT TITLE</b> INHIBITOR, ICING, FUEL SYSTEM, HIGH FLASH, NATO CODE NUMBER S-1745														
<b>4. NATURE OF CHANGE</b> ( <i>Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.</i> )														
<b>5. REASON FOR RECOMMENDATION</b>														
<b>6. SUBMITTER</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;">a. NAME (<i>Last, First, Middle Initial</i>)</td> <td colspan="2" style="width: 50%; padding: 2px;">b. ORGANIZATION</td> </tr> <tr> <td style="padding: 2px;">c. ADDRESS (<i>Include ZIP Code</i>)</td> <td style="width: 50%; padding: 2px;">d. TELEPHONE (<i>Include Area Code</i>)</td> <td style="width: 50%; padding: 2px; vertical-align: top;"><b>7. DATE SUBMITTED</b> (YYYYMMDD)</td> </tr> <tr> <td></td> <td style="padding: 2px;">(1) Commercial (732) 323-2947</td> <td style="padding: 2px;"></td> </tr> <tr> <td></td> <td style="padding: 2px;">(2) DSN (If applicable)</td> <td style="padding: 2px;"></td> </tr> </table>			a. NAME ( <i>Last, First, Middle Initial</i> )	b. ORGANIZATION		c. ADDRESS ( <i>Include ZIP Code</i> )	d. TELEPHONE ( <i>Include Area Code</i> )	<b>7. DATE SUBMITTED</b> (YYYYMMDD)		(1) Commercial (732) 323-2947			(2) DSN (If applicable)	
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	(1) Commercial (732) 323-2947													
	(2) DSN (If applicable)													
<b>8. PREPARING ACTIVITY</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;">a. NAME COMMANDER NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION</td> <td colspan="2" style="width: 50%; padding: 2px;">b. TELEPHONE (<i>Include Area Code</i>) (1) Commercial (732) 323-2947      (2) DSN 624-2947</td> </tr> <tr> <td style="padding: 2px;">c. ADDRESS (<i>Include ZIP Code</i>) CODE 414100B120-3 HIGHWAY 547 LAKEHURST, NJ 08733-5100</td> <td colspan="2" style="padding: 2px; vertical-align: top;"> <b>IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:</b>            Defense Standardization Program Office (DLSC-LM)            8725 John J. Kingman Road, Suite 2533            Fort Belvoir, Virginia 22060-6221            Telephone (703) 767-6888    DSN 427-6888         </td> </tr> </table>			a. NAME COMMANDER NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION	b. TELEPHONE ( <i>Include Area Code</i> ) (1) Commercial (732) 323-2947      (2) DSN 624-2947		c. ADDRESS ( <i>Include ZIP Code</i> ) CODE 414100B120-3 HIGHWAY 547 LAKEHURST, NJ 08733-5100	<b>IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:</b> Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman Road, Suite 2533 Fort Belvoir, Virginia 22060-6221 Telephone (703) 767-6888    DSN 427-6888							
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METRIC

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SUPERSEDING  
MIL-PRF-25017H  
25 March 2011

**PERFORMANCE SPECIFICATION**

**INHIBITOR, CORROSION / LUBRICITY IMPROVER,  
FUEL SOLUBLE (NATO S-1747)**



Comments, suggestions, or questions on this document should be addressed to AFPA/PTPT, 2430 C Street, Bldg 70, Area B, Wright-Patterson AFB OH 45433-7632 or e-mailed to [AFPET.AFTT@wpafb.af.mil](mailto:AFPET.AFTT@wpafb.af.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.daps.dla.mil>.

AMSC N/A

FSC 6850

**DISTRIBUTION STATEMENT A.** Approved for public release; distribution is unlimited.

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This specification is approved for use by all Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers one type of fuel-soluble corrosion inhibitor/lubricity improver additive for use in aviation turbine fuel, motor gasoline, diesel fuel, and related petroleum products.

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

### 2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

### FEDERAL STANDARDS

FED-STD-313	Material Safety Data, Transportation Data, and Disposal Data for Hazardous Materials Furnished to Government Activities
FED-STD-791	Testing Method of Lubricants, Liquid Fuels, and Related Products

### DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-PRF-7024	Calibrating Fluids, Aircraft Fuel System Components
MIL-PRF-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-DTL-25524	Turbine Fuel, Aviation, Thermally Stable
MIL-DTL-83133	Turbine Fuel, Aviation, Kerosene Type, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37)
MIL-DTL-85470	Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745

(Copies of the above documents are available online at <https://assist.daps.dla.mil/quicksearch> or <http://assistedocs.com>, or from the Standardization Document Order Desk, 700 Robbins Avenue, Bldg 4D, Philadelphia PA 19111-5094)

2.3 Non-government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

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## ASTM INTERNATIONAL

ASTM A108	Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished (DoD adopted)
ASTM D56	Standard Test Method for Flash Point by Tag Closed Cup Tester (DoD adopted)
ASTM D93	Standard Test Methods for Flash-Point by Pensky-Martens Closed Cup Tester (DoD adopted)
ASTM D97	Standard Test Method for Pour Point of Petroleum Products (DoD adopted)
ASTM D445	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity) (DoD adopted)
ASTM D471	Standard Test Method for Rubber Property – Effect of Liquids (DOD adopted)
ASTM D482	Standard Test Method for Ash From Petroleum Products (DoD adopted)
ASTM D664	Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration (DoD adopted)
ASTM D665	Standard Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water (DoD adopted)
ASTM D975	Standard Specification for Diesel Fuel Oils (DoD adopted)
ASTM D1298	Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method (DoD adopted)
ASTM D2274	Standard Test Method for Oxidation Stability of Distillate Fuel Oil (Accelerated Method) (DoD adopted)
ASTM D2624	Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels (DoD adopted)
ASTM D3948	Standard Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer (DoD adopted)
ASTM D4052	Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter (DoD adopted)
ASTM D4057	Standard Practice for Manual Sampling of Petroleum and Petroleum Products (DoD adopted)
ASTM D4308	Standard Test Method for Electrical Conductivity of Liquid Hydrocarbons by Precision Meter (DoD adopted)
ASTM D4814	Standard Specification for Automotive Spark-Ignition Engine Fuel (DoD adopted)
ASTM D5001	Standard Test Method for Measurement of Lubricity of Aviation Turbine Fuels by the Ball-on-Cylinder Lubricity Evaluator (BOCLE) (DoD adopted)
ASTM D5949	Standard Test Method for Pour Point of Petroleum Products (Automatic Pressure Pulsing Method)
ASTM D5950	Standard Test Method for Pour Point of Petroleum Products (Automatic Tilt Method)

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ASTM D5985	Standard Test Method for Pour Point of Petroleum Products (Rotational Method)
ASTM D6421	Standard Test Method for Evaluating Automotive Spark-Ignition Engine Fuel for Electronic Port Fuel Injector Fouling by Bench Procedure

(Copies of these documents are available at ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. Electronic copies of ASTM standards may be obtained from <http://www.astm.org>.)

**2.4 Order of precedence.** In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

**3.1 Qualification.** The additives furnished under this specification shall be products that are authorized by the Qualifying Activity for listing on the applicable Qualified Products List (QPL) before contract award (see 4.2 and 6.6).

**3.1.1 Qualification requirements.** The qualification requirements for the additives are listed for each type of fuel. All approved additives shall meet the requirements of 3.2 through 3.12, 3.16, and 3.17 to be qualified for use in fuels which conform to MIL-DTL-5624, MIL-PRF-7024, MIL-DTL-25524, and MIL-DTL-83133. To qualify for use in motor gasolines (ASTM D4814) and diesel fuels (ASTM D975), the additive shall meet the requirements of 3.2 through 3.17. Category 2 additives are approved for use in fuels which conform to MIL-DTL-5624, MIL-PRF-7024, MIL-DTL-25524 and MIL-DTL-83133. In addition to the previously mentioned specifications, Category 1 additives are also approved for use in fuels which conform to ASTM D975 and ASTM D4814 (see Table I).

**3.2 Materials.** The composition of the finished additive is not limited but is subject to review by the Qualifying Activity to ensure service compatibility with previously qualified products.

**3.2.1 Toxic products and formulations.** The materials shall have no adverse effect on the health of personnel when used for their intended purpose. Questions pertinent to this effect shall be referred by the Procuring Activity to the appropriate departmental medical service, which will act as an advisor to the Procuring Activity (see 6.4).

**3.3 Solubility.** The maximum allowable concentration of additive, as defined in 3.7, shall be readily and completely dissolvable in all fuels for which it is qualified. There shall be no precipitation, cloudiness, or other evidence of insolubility when tested as specified in 4.4.1.

**3.4 Compatibility.** The additive shall be compatible with all those currently qualified under this specification, with all the static dissipater additive(s) allowed in MIL-DTL-83133, and with all the thermal stability improver additive(s) allowed in MIL-DTL-83133. There shall be no precipitation, cloudiness, or other evidence of non-compatibility when tested as specified in 4.4.2.

**3.5 Relative effective concentration.** The relative effective concentration shall be determined in accordance with 4.4.3 and shall be expressed in grams of finished additive per cubic meter of fuel. The relative effective concentration shall not be less than 6 grams of additive per cubic meter of fuel ( $6 \text{ g/m}^3$ ), not more than  $36 \text{ g/m}^3$ , and shall be approved at concentrations divisible by 3 (i.e.; 6, 9, 12, 15, ...  $36 \text{ g/m}^3$ ). The relative effective concentration shall be identified by the Qualifying Activity and cited on QPL-25017.

**3.6 Minimum effective concentration.** The minimum effective concentration shall be the larger of the following:

- a. One and one-half (1.5) times the relative effective concentration, as defined in 3.5, rounded to the next whole number of grams per cubic meter (i.e.; 9, 14, 18, 23, ...  $54 \text{ g/m}^3$ ).

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b. The amount of additive (in whole numbers of grams per cubic meter; e.g.; 9, 10, 11, 12, ... g/m<sup>3</sup>) that gives a wear scar diameter of 0.65 mm or less when tested for lubricity using the Ball-on-Cylinder Lubricity Evaluator (BOCLE), as specified in 4.4.4.1.

The minimum effective concentration shall be identified by the Qualifying Activity and cited on QPL-25017.

**3.7 Maximum allowable concentration.** The maximum allowable concentration shall be the lowest of the following (all expressed in grams of additive per cubic meter of fuel):

- a. Fifty-four grams of additive per cubic meter of fuel (54 g/m<sup>3</sup>).
- b. Four times the relative effective concentration, as defined in 3.5.
- c. The highest concentration that results in a Micro-Separometer Rating (MSEP) of 70 or higher when determined in accordance with 4.4.5.1.
- d. The highest concentration that results in a less-than-40-percent change in electrical conductivity with fuel that contains static dissipater additive (see 4.4.2.2).

The maximum allowable concentration shall be identified by the Qualifying Activity and cited on QPL-25017.

**3.8 Ash content.** The ash content shall not be greater than 0.10 percent mass when determined in accordance with 4.4.6.

**3.9 Pour point.** The pour point shall not be greater than –18°C when determined as specified in 4.4.7.

**3.10 Aircraft turbine engine operation.** Grade JP-8 (MIL-DTL-83133) or JP-5 (MIL-DTL-5624) fuel that contains twice the maximum allowable concentration (see 3.7) of the additive shall be tested in accordance with 4.4.8 to determine its acceptability for turbine engine use. Engine operation shall not be adversely affected and the post-test condition of the engine shall indicate no excessive deposits, water, corrosion, or other adulteration, attributable to the additive.

**3.11 Specification requirements.** A blend of the additive at its maximum allowable concentration in a representative fuel shall meet all of the requirements of each applicable specification when tested in accordance with 4.4.9. For example, to be qualified for use in a motor gasoline, a gasoline that conforms to ASTM D4814 shall continue to meet all applicable requirements of ASTM D4814 after the maximum allowable concentration of the additive is added.

**3.12 Storage stability.** After stored for 12 months in accordance with 4.4.10, the additive shall show no precipitation, layering, or other evidence of gross separation or degradation. Additive that represents the top-half of the stored sample shall meet all requirements of this specification except 3.10.

**3.13 Fuel Injection fouling.** Additive for use in motor gasolines that conform to ASTM D4814 shall pass the fuel injection fouling bench procedure performed in accordance with 4.4.11.

**3.14 Emulsification tendency.** To obtain approval for use in motor gasolines that conform to ASTM D4814 and diesel fuels that conform to ASTM D975, the additive shall pass the emulsification tendency test performed in accordance with 4.4.12.

**3.15 Accelerated stability.** The additive shall pass the accelerated stability test performed in accordance with 4.4.13 before approved for use in diesel fuels that conform to ASTM D975.

**3.16 Identification qualification data.** The following properties of the finished additive shall be determined but not limited during qualification: density at 15°C, viscosity at 40°C, flash point, neutralization number, pH, and type of metallic constituent, if present (see 4.4.14). The permissible production variation of individual properties shall be established at the time of qualification by mutual agreement between the manufacturer and the Qualifying Activity. Individual batches of additive subsequently subjected to qualification conformance inspections shall conform to the established range of properties. The ranges shall not adversely affect any of the additive performance characteristics such as relative effective concentration and MSEP.

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3.17 Workmanship. The finished product in bulk or container shall be uniform in appearance and visually free from grit, un-dissolved water, insoluble components, or other adulteration.

## 4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Conformance inspection (see 4.3).

4.2 Qualification inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in 4.4.

4.2.1 Qualification sampling. Unless otherwise specified by the activity responsible for qualification, an initial 1-liter sample of finished product shall be submitted for evaluation by all the tests required in 3.1.1, with the exception of the storage stability (3.12) and aircraft turbine engine test (3.10), to an independent laboratory approved by the Qualifying Activity. If the product passes all the tests, an additional sample of finished product will be required for the storage stability and aircraft turbine engine tests. The additional samples shall be identified as required and forwarded to the Qualifying Activity (see 6.6).

4.2.2 Requalification. Requalification will be required in the event any change in composition or formulation, source of additive or its ingredients, or manufacturing practice or site occurs.

4.2.3 Retention of qualification. The retention of qualification of products approved for listing on the Qualified Products List (QPL) shall be accomplished by a periodic verification to determine continued compliance of a supplier's product with the requirements of this specification. The verification intervals shall not exceed two years. Unless otherwise specified by the activity responsible for the Qualified Products List, verification of qualification may be made by certification.

4.3 Conformance inspection. Quality conformance inspection of a bulk lot, prior to becoming a packaged lot, of additive shall consist of tests for conformance requirements for ash content (3.8), pour point (3.9), MSEP (3.7), BOCLE (3.6.), and the property limits (3.16) shown on the Qualified Products List. (see Table I)

4.3.1 Inspection lots.

4.3.1.1 Bulk lot. A bulk lot is defined as an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single, isolated container manufactured through the same processing equipment with no change in ingredient material.

4.3.1.2 Packaged lot. A packaged lot is defined as an indefinite number of 208-liter (55-gallon) drums or smaller unit packages of identical size and type, or an indefinite number of 2080-liter (550-gallon) or less returnable containers, such as totes, offered for acceptance and filled with a homogenous mixture of material from a bulk lot.

4.3.2 Sampling. Each bulk or packaged lot of material shall be sampled for verification of product quality and compliance in accordance with ASTM D4057.

4.4 Methods of inspection.

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Characteristic	Qualification Test	Conformance Test	Requirement Paragraph	Test Method Paragraph
Material Compatibility	Required		3.2	
Solubility in Fuel	Required		3.3	4.4.1
Compatibility with other Fuel Additives	Required		3.4	4.4.2
Rust Test	Required		3.5	4.4.3.1
Lubricity Test	Required	Required	3.6	4.4.4.1, ASTM D5001
Water Separation	Required	Required	3.7	4.4.5.1, ASTM D3948
Electrical Conductivity	Required		3.7	4.4.2.2, ASTM D2624 or ASTM D4308
Ash Content	Required	Required	3.8	4.4.6, ASTM D482
Pour Point	Required	Required	3.9	4.4.7, ASTM D97 or ASTM D5949 or ASTM D5950 or ASTM D5985
Engine Operation	Required		3.10	4.4.8
Fuel Specification Properties	Required		3.11	4.4.9
Storage Stability	Required		3.12	4.4.10
Fuel Injection Fouling (Bench Procedure)	Required for Category 1 Qualification		3.13	4.4.11, ASTM D6421
Emulsification Tendency	Required for Category 1 Qualification		3.14	4.4.12, Method 550 of FED-STD-791
Accelerated Stability	Required for Category 1 Qualification		3.15	4.4.13, ASTM D2274
Density	Required	Required	3.16	4.4.14, ASTM D1298 or pycnometer or ASTM D4052
Viscosity	Required	Required	3.16	4.4.14, ASTM D445
Flash Point	Required	Required	3.16	4.4.14, ASTM D56 or ASTM D93
Neutralization Number	Required	Required	3.16	4.4.14, ASTM D664
pH	Required		3.16	4.4.14, ASTM D664
Metallic Constituent	Required		3.16	4.4.14
Workmanship	Required		3.17	

**4.4.1 Solubility.** The maximum allowable concentration of additive shall be mixed with each of the following fuels. The fuel shall contain no other additives. Immediately after mixing and at the end of 24 hours, the samples shall be visually inspected for precipitation, cloudiness, or other evidence of insolubility

- . a. JP-5 fuel that conforms to MIL-DTL-5624 or JP-8 fuel that conforms to MIL-DTL-83133 and contains the maximum allowable concentration of specified fuel system icing inhibitor.

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- b. JP-4 fuel that conforms to MIL-DTL-5624 and contains the maximum allowable concentration of specified fuel system icing inhibitor.
- c. A motor gasoline that conforms to ASTM D4814 (required only if additive is to be qualified for use in motor gasolines).
- d. A diesel fuel that conforms to ASTM D975 (required only if additive is to be qualified for use in diesel fuel).

**4.4.2 Compatibility.**

4.4.2.1 Other additives. Grade JP-8 fuel (MIL-DTL-83133) or grade JP-5 fuel (MIL-DTL-5624) that contains the maximum allowable concentration of the additive under test and no other additives shall be mixed in equal proportions with samples of grade JP-8 fuel (MIL-DTL-83133) or grade JP-5 fuel (MIL-DTL-5624), respectively, which contain the maximum allowable concentration of each additive currently on the Qualified Products List for this specification. The grade JP-8 fuel (MIL-DTL-83133) or grade JP-5 fuel (MIL-DTL-5624) used shall contain the maximum allowable amount of fuel system icing inhibitor that conforms to MIL-DTL-85470. At the end of a 24 hour period, the samples shall be visually inspected for precipitation, cloudiness, or other evidence of non-compatibility.

4.4.2.2 Static dissipater additive. Grade JP-8 fuel (MIL-DTL-83133) filtered through clay as described in appendix X.1 of ASTM D3948 shall be blended with each static dissipater additive approved in MIL-DTL-83133 to provide test fuels which have a conductivity of 400 picosiemens per meter ( $\mu\text{S}/\text{m}$ ) $\pm 100 \mu\text{S}/\text{m}$ . After a 24 hour period, to ensure equilibrium fuel conductivity has been established, the additive under test shall be added and mixed. At the end of another 24 hour period, no more than a  $\pm 40$  percent change in the electrical conductivity of the fuel shall have occurred as a result of the test additive. The fuel electrical conductivity shall be measured using either ASTM D2624 or ASTM D4308 test methods. The post-test visual inspection of the sample shall reveal no precipitation, cloudiness, or other evidence of incompatibility. (NOTE: Some loss in fuel conductivity may occur over time when bare glass bottles or bare metal cans are used with fuels which contain static dissipater additives. The use of an epoxy-coated container is suggested. Also, fuel conductivity is temperature sensitive; no significant change in temperature should be allowed during the test).

4.4.2.3 Thermal stability improver additive. Grade JP-8 fuel (MIL-DTL-83133) filtered through clay as described in appendix X.1 of ASTM D3948 shall be blended with each thermal stability improver additive approved in MIL-DTL-83133 at the specified concentration. The additive under test shall be added at its maximum allowable concentration and mixed. At the end of a 24 hour period, the samples shall be visually inspected for precipitation, cloudiness, or other evidence of non-compatibility.

4.4.3 Relative effective concentration. The relative effective concentration of the additive shall be determined by testing the additive at various concentrations in depolarized *iso*-octane in accordance with 4.4.3.1. The additive shall be tested at concentrations divisible by 3 (i.e.; 6, 9, 12, 15, ... 36 g/m<sup>3</sup>). No intermediate concentrations shall be tested. The relative effective concentration shall be defined as the lowest concentration that provides a passing result in accordance with 4.4.3.1.6.

**4.4.3.1 Rusting test method.****4.4.3.1.1 Test apparatus.** The test apparatus shall conform to the following requirements:

- a. Oil bath that conforms to ASTM D665, with the additional requirement that it must be able to maintain the test sample at a temperature of  $38.0^\circ\text{C} \pm 0.5^\circ\text{C}$ .
- b. Beaker, beaker cover, stirrer, stirring apparatus, and chuck and motors to hold and rotate specimens while polished shall conform to ASTM D665.
- c. Infrared heat lamp, 250 watts.
- d. Hypodermic syringe, glass, 3-mL, with 15.24-cm (6-inch) stainless steel needles.
- e. Disposable microliter pipettes which consist of calibrated capillary tubes that contain 1, 2, 3, 4, 5, 10, 15, and 20 microliters.

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- f. Column, chromatographic, glass, 40 mm ID x 600 mm with nonmetallic stopcock. A separatory funnel, Squibb, 1 liter, with nonmetallic stopcock may be substituted for the chromatographic column.
- g. Specimen holder, nonmetallic, dimensions as specified in ASTM D665 for type 2 holder.
- h. Specimen, dimensions as specified in ASTM D665, made of grade 1018 steel in accordance with ASTM A108. The specimen shall be fabricated from 1.58 cm (0.625 inch) diameter round stock by machining or grinding to the final diameter of 1.27 cm (0.50 inch). The specimen may be reused from test to test but shall be discarded when the diameter is reduced to 0.953 cm (0.375 inch) or less.

**4.4.3.1.2 Test materials.** Test materials shall conform to the following requirements:

- a. Silica gel, 28-200 mesh, heated to 107 °C (225 °F) for 2 hours and cooled in a dessicator before use.
- b. Test solvent, *iso*-octane that conforms to ASTM D471, which has been freshly depolarized as follows:  
  
A glass chromatographic column or 1 L separatory (Squibb) funnel is filled with silica gel to a height 20 cm above the stopcock; the silica gel is retained by a glass wool plug. (NOTE: Do not use stopcock grease.) One gallon (3.79 liters) of *iso*-octane is passed through the silica-gel bed by gravity, the first 50 mL discarded, and the remainder collected in a chemically clean glass container. The depolarized *iso*-octane should be used within one week after treatment.
- c. Test water, Type B medium hard, prepared as follows: Prepare 3 stock solutions using ACS reagent-grade chemicals in distilled water. Each one of the solutions shall contain one of these chemicals: 16.4 g/L NaHCO<sub>3</sub>, 13.2 g/L CaCl<sub>2</sub> · 2H<sub>2</sub>O, and 8.2 g/L MgSO<sub>4</sub> · 7H<sub>2</sub>O. Pipette 10 mL of the NaHCO<sub>3</sub> stock solution into 800 mL of distilled water in a 1 L volumetric flask, and shake vigorously. While swirling the contents of the flask, pipette 10 mL of the CaCl<sub>2</sub> stock solution and then 10 mL of the MgSO<sub>4</sub> stock solution into the flask, add distilled water to bring the volume to 1 L, and mix thoroughly. The final blend shall be clear and free of precipitation.
- d. Isopropanol, ACS reagent grade.
- e. Glassware cleaning solution.
- f. Lintless paper tissues such as Kimtech Science Kimwipes Delicate Task Wipers.
- g. Abrasive cloth, 150-, 240-, and 400-grit metalworking aluminum oxide abrasive cloth, closed coat on jeans backing. The abrasive cloth is available in rolls of 1 inch (2.54 cm) tape, the most convenient form for use in this test.
- h. Disposable vinyl gloves.

**4.4.3.1.3 Specimen preparation.** The specimen, whether new or reused from a previous test, shall be cleaned by solvent rinsing or brushing as needed to remove oily residues, loose rust, or foreign material. After this preliminary cleaning, the specimen shall be handled only with vinyl gloves. (NOTE: It is essential to avoid contamination of the specimen, particularly by perspiration residues. Care should be taken to avoid transfer of such contaminants to the specimen via the abrasive cloth or the lintless paper tissues.) The specimen shall then be ground successively with 150-, 240-, and 400-grit abrasive cloth while mounted in the chuck of the grinding and polishing apparatus and turned at 1700 to 1800 rpm, in accordance with the following procedures:

- a. Grind with 150-grit cloth to remove all defects, irregularities, pits, and scratches, as determined by visual inspection. Old 150-grit cloth may be used to remove rust or major irregularities, but grinding shall be completed with new cloth. Stop the motor and scratch the static specimen longitudinally with one pass of new 150-grit cloth. Use light pressure so visible scratches appear.
- b. Grind with 240-grit cloth, remove all marks from the 150-grit cloth, and finish with new 240-grit cloth. Stop the motor and scratch the static specimen longitudinally with one pass of new 240-grit cloth; use light pressure so visible scratches appear.

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- c. Polish with 400-grit cloth by wrapping a strip of cloth halfway around the specimen and applying a firm but gentle downward pull to the ends of the strip. Move the strip slowly along the specimen. Shift the position of the abrasive cloth frequently to expose fresh abrasive to the specimen. Continue this procedure using new strips of abrasive cloth, as required, until all marks from the previous 240-grit operation have been removed and the surface presents a uniform appearance, free of longitudinal or spiral scratches, where all polishing marks appear to be circumferential. The final passes along the specimen shall be made with fresh abrasive cloth.
- d. Remove the specimen from the chuck, wipe with lintless tissue, and store in a beaker of depolarized *iso*-octane in a desiccator that contains silica gel or other noncorrosive desiccant until ready for use. The storage period in the *iso*-octane shall not exceed 7 days.

**4.4.3.1.4 Preparation of test blend.** The test blend shall be prepared in the test beaker, not more than 2 hours before immersion of the specimen in the test blend. The test blend shall be prepared in accordance with the following procedure:

- a. Clean the test beaker with a suitable cleaning solution (see note, below). Clean the stainless steel stirrer and methyl methacrylate beaker cover by rinsing in any suitable aliphatic hydrocarbon solvent such as a light naptha or *iso*-octane, washing thoroughly with hot distilled water, and oven drying (not over 65.6°C for cover). (NOTE: If a glass stirrer or beaker cover is used, it should be cleaned in the same manner as the test beaker. Any suitable cleaning method that provides cleaning quality comparable to the use of chromic acid may be used. The use of a detergent cleaning solution is suggested. Use stainless steel forceps to handle the glassware. Wash with tap water and then with distilled water. Rinse with reagent grade isopropyl alcohol and air or oven dry. Detergent cleaning avoids the potential hazards and inconvenience associated with handling corrosive chromic acid solution. The latter remains as the reference cleaning practice and as such may function as an alternative to the preferred use of detergent solutions).
- b. Prepare the blend of *iso*-octane and additive in the test beaker with direct addition of the additive. No intermediate blends, concentrates, or stock solutions are permitted. Prepare each test blend using between 300 and 400 mL of *iso*-octane in the test beaker. Use pipette or pipettes to add integral numbers of µL of the additive to the beaker to increase measurement accuracy. Add the calculated volume of depolarized *iso*-octane to the test beaker. Fill the appropriate microliter pipette or pipettes with additive, wipe off excess, and force the additive into the *iso*-octane. Allow the pipette to fill with *iso*-octane by capillary attraction and force this rinse into the test beaker. Repeat the rinse 4 times. Calculate the amount of *iso*-octane and additive to be added to the test beaker using the instructions given in 4.4.3.1.4.c.
- c. Calculate the volume of *iso*-octane required for each concentration desired using the following equation, where density ( $\rho$ ) is in g/mL at 15°C:

$$mL \text{ of } iso - octane = \frac{(\rho \text{ of additive})x (\mu L \text{ of additive})x (1000)}{\text{desired additive concentration, g/m}^3}$$

For example, assume the additive has a density of 0.95 and the desired concentration is 6 grams/cubic meter of fuel. Calculate the volume of *iso*-octane required when using 2 µL of additive:

$$mL \text{ of } iso - octane = \frac{(0.95)x (2)x (1000)}{6} = 316.7 \text{ mL}$$

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For additives less dense than 0.9 g/mL, the volume of *iso*-octane for many concentrations of interest will be less than 300 mL or more than 400 mL. Use the following procedure:

- (1) Calculate the volume of additive required for 300 mL of *iso*-octane.
- (2) Increase the volume of additive to the next integral microliter and add to 300 mL of *iso*-octane in the test beaker. Mix well.
- (3) Calculate the amount of additive/*iso*-octane blend to be removed from the test beaker to leave the desired amount of additive.
- (4) Remove the calculated amount of additive/*iso*-octane blend and replace with an equivalent volume of depolarized *iso*-octane. Mix well. This approach is illustrated for the preceding example:

(a) Using this equation, calculate the desired volume of additive for 300 mL of *iso*-octane for an additive with a density of 0.85 and for a desired concentration of 6 g/m<sup>3</sup>.

$$300 \text{ mL of } iso - octane = \frac{(0.85)x (Z \mu\text{L of additive})x (1000)}{6}$$

$$Z = 2.12 \mu\text{L of additive}$$

(b) Add the next integral volume of additive (i.e., 3 μL) to 300 mL of *iso*-octane and mix well. This gives an additive concentration of 3 μL additive/300 mL *iso*-octane or 1 μL /100 mL.

(c) The desired amount of additive is 2.12 μL. Thus, (2.12) × (100) = 212 mL of additive/*iso*-octane blend is needed.

(d) Remove 88 mL of the additive/*iso*-octane blend (i.e., 300 - 212 = 88 mL). Replace with 88 mL of the depolarized *iso*-octane. Mix well. This results in the correct volume of additive (i.e., 2.12 μL) in 300 mL of *iso*-octane.

d. Place the beaker in the oil bath which has been regulated previously to maintain a sample temperature of 38.0°C ± 0.5°C. The beaker is inserted in a hole of the bath cover and suspended at a level such that the oil level in the bath is not below the sample level in the beaker. Cover the beaker with the beaker cover and the stirrer in position. Adjust the stirrer so the shaft is 6 mm off-center in the beaker, and the blade is within 2 mm of the bottom of the beaker. Then suspend a thermometer through the hole in the cover intended for that purpose, so that it is immersed to a depth of 57 mm. Stir for at least 5 minutes. Turn off the stirrer. Use a clean pipette or syringe to withdraw enough test blend to leave exactly 300 mL in the beaker. Allow the test blend to come to 38.0°C ± 0.5°C. Replace the thermometer with a cork or plastic plug.

4.4.3.1.5 Test procedure. After preparing a test specimen as described in 4.4.3.1.3 and a test blend as described in 4.4.3.1.4, the test shall be performed in accordance with the following procedure:

a. Remove a test specimen from the *iso*-octane in the desiccator and wipe dry with a lintless paper tissue; handle the specimen with vinyl gloves throughout this step and the following operations. Repolish with 400-grit abrasive cloth by wrapping a strip of the cloth halfway around the specimen and applying a firm but gentle downward pull to the ends of the strip. Move the strip slowly along the specimen, twice in each direction, shifting the strip after the first back-and-forth pass so fresh abrasive is exposed to the specimen. Inspect the specimen to ensure the surface presents a uniform appearance, free of longitudinal or spiral scratches, where all polishing marks appear to be circumferential. Additional polishing is required if the specimen appearance is other than described. After polishing is completed, remove the specimen from the chuck, wipe lightly with lintless paper tissue, and screw the specimen into the specimen holder. Rinse the specimen with a stream of isopropanol from a wash bottle. Wipe dry immediately, wiping twice with fresh lintless paper tissues, using firm pressure and rotating the specimen while drawing through the tissue. (NOTE: Under conditions of high ambient humidity, it is necessary to heat the specimen to prevent condensation of moisture and premature rusting. Under such conditions, place the specimen and holder 6 inches

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from a 250-watt infrared heat lamp and rotate for 1 minute before the rinsing operation. Keep the specimen under the lamp while proceeding with the rinsing and wiping operations.)

- b. Immediately after rinsing and wiping, insert the specimen and holder through the specimen hole in the beaker cover and suspend the specimen so that its lower end is 13 to 15 mm from the bottom of the beaker. Leave the specimen in the test blend for a 10 minute static soak, then turn on the stirrer and soak dynamically for 20 minutes. (NOTE: When multiple tests are run simultaneously, it is permissible to extend the static soak period to not more than 40 minutes in the case of the "first-in" specimen, giving the "last-in" specimen a 10 minute soak.)
- c. Turn off the stirrer. Remove the cork or plug from the beaker cover. Carefully add 30 mL of test water to the bottom of the test beaker by means of a hypodermic syringe. Change to a clean needle for each test beaker. Replace the cork or plug in the beaker cover.
- d. Start the stirrer immediately and run for 5 hours; hold the bath temperature at the same setting so the test samples will be maintained at  $38.0^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$ .
- e. At the end of 5 hours, stop the stirrer, remove the specimen and holder, rinse immediately with isopropanol, and allow to air dry. Examine at once without magnification under normal indoor illumination, approximately 646 lux or 60 foot-candles. Scan the surface very carefully to detect any small pits. Record observations of visible rust, pits, stains, or deposits.

**4.4.3.1.6 Interpretation of test results.** A test shall be reported as failed if the center 48 mm section of the specimen shows 6 or more rust spots of any size, or if it shows any rust spot 1 mm in diameter or larger. (NOTE: The ends of the specimen, outside the center section, are ignored in rating the specimen.) Visible deposits or stains other than rust shall not constitute failure; deposits or stains may be examined microscopically to determine their classification. In order to assign a pass-fail rating to a given additive at a given concentration, two tests shall be performed. The additive shall be reported as passing at the given concentration if both tests give passing ratings, or failure at the given concentration if both tests give failing ratings. If the two tests give one passing rating and one failing, two additional tests shall be performed. If either or both of these additional tests give a failing rating, the additive shall be reported as failing at the given concentration. If both of the additional tests give passing ratings, the additive shall be reported as passing the given concentration.

**4.4.4 Minimum effective concentration.**

**4.4.4.1 Lubricity test.** The additive shall be tested in accordance with the BOCLE as described in ASTM D5001, using ISOPAR M as the solvent and a 1000 g load on the ball.

**4.4.5 Maximum allowable concentration.**

**4.4.5.1 Micro-Separometer Rating.** The additive shall be blended into the reference fluid base as described in ASTM D3948 and tested in accordance with ASTM D3948. For any given concentration of additive, the average of three test results shall be used to determine the conformance to the requirements of 3.7 or 4.3.

**4.4.6 Ash content determinations.** The ash content of the finished product shall be determined in accordance with ASTM D482, using a platinum or porcelain crucible.

**4.4.7 Pour point determination.** Pour point shall be determined in accordance with ASTM D97, ASTM D5949, ASTM D5950, or ASTM D5985.

**4.4.8 Aircraft engine test.** The engine shall be operated for 100 hours in accordance with the engine operating requirements of MIL-PRF-7808. The fuel, grade JP-8 fuel that conforms to MIL-DTL-83133 or grade JP-5 fuel that conforms to MIL-DTL-5624, shall contain twice the maximum allowable concentration of the additive. Upon completion of the test, components of the engine exposed to the fuel—such as fuel controls, fuel nozzles, combustion section, turbine blades, exhaust section, elastomers, fuel/oil heat exchangers, and fuel pumps—shall be examined for evidence of excess wear, deposits, corrosion, or other deleterious effects. This test shall be performed by the activity responsible for qualification (see 6.6).

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4.4.9 Specification tests. The additive shall be added at its maximum allowable concentration to a base fuel that does not contain it but is otherwise representative of each grade of fuel for which the additive is to be qualified. The blend of fuel and additive shall be subjected to all of the tests of each applicable specification.

4.4.10 Storage stability test. Two 1 L or 1 qt amber glass bottles shall each be filled with 850 mL of the additive and shall be tightly capped by means of a screw cap that has a conical, polyethylene liner. Each bottle shall be wrapped in a minimum amount of opaque packing materials sufficient for protection against mechanical damage, but minimal in thermal insulation qualities. The wrapped bottles shall be enclosed in a tight wooden or metal box for further protection against breakage and sunlight. The crated samples shall be stored at ambient outdoor conditions in a temperate climate. The box shall be kept off the ground and protected from direct sunlight and precipitation under a canopy, open shed roof, or similar ventilated shelter. The crated samples shall be stored undisturbed in an upright position for the specified period. One of the samples shall be stored for exactly 12 months and then removed for examination and testing; the other sample shall be stored for 12 months or less and may be removed for examination and testing at any time, at the option of the Qualifying Activity. Whenever a sample is removed for examination and testing, it shall be uncrated with minimum disturbance; the bottle shall not be shaken, inverted, or otherwise agitated. The contents of the bottle shall be inspected visually for precipitation, separation into layers, or other evidence of gross separation. The presence or absence and the nature of such separation shall be recorded. The top half of the liquid sample shall be carefully removed by suction or siphoning into another bottle, without disturbing the bottom half of the original sample. The top half sample, after transfer to the second bottle, shall be shaken thoroughly and then used in laboratory testing performed in accordance with 3.12. The bottom half sample, in the original storage bottle, shall be retained for examination and possible additional testing to detect changes caused by storage.

4.4.11 Fuel injection fouling test. The additive, at its maximum concentration, shall be blended into an ASTM D4814 motor gasoline. The test fuel shall then be tested for the formation of deposits in accordance with ASTM D6421. The ASTM D4814 gasoline without additive shall also be tested in accordance with ASTM D6421. The resultant difference between the gasoline with additive versus without additive shall not exceed one percent of the fuel injector fouling.

4.4.12 Emulsification tendency test. The additive, at maximum allowable concentration, shall be blended into an ASTM D4814 motor gasoline and a biodiesel-free ASTM D975 diesel fuel. Each test fuel shall then be examined for emulsification tendencies in accordance with Method 550 of FED-STD-791. Interface ratings in excess of 3 are evidence of unsatisfactory emulsification tendencies and shall not be allowed. The ASTM D4814 motor gasoline and the biodiesel-free ASTM D975 diesel fuel shall also be tested in accordance with Method 550 of FED-STD-791 to identify the quality of the fuels before the addition of the additive.

4.4.13 Accelerated stability test. The test additive, at its maximum allowable concentration, shall be blended into a biodiesel-free ASTM D975 diesel fuel that contains no additives. Each test fuel shall be tested for the formation of total insolubles in accordance with ASTM D2274. The total insolubles shall not exceed 1.5 mg/100 mL. The diesel fuel without the test additive shall also be tested in accordance with ASTM D2274 concurrently to define the level of insolubles occurring without the presence of the additive.

4.4.14 Identification tests. Identification tests shall be conducted in accordance with the following methods:

Density at 15°C	ASTM D1298 or pycnometer or ASTM D4052
Viscosity at 40°C	ASTM D445
Flash Point	ASTM D56 or ASTM D93
Neutralization Number	ASTM D664, Total Acid Number
pH	On a 0.10 - 0.11 gram sample in 125 mL of ASTM D664 titration solvent. Use the same apparatus as used in ASTM D664 to perform pH measurement.

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Metallic Constituent	Emission spectrograph, not applicable for materials with ash contents of 0.05 percent mass or lower.
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## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The additives covered by this specification are used, when specifically authorized, in military jet engine fuels, for the prevention of corrosion in handling, transportation, and storage equipment and to improve the lubricating qualities of military jet fuels. Certain of the additives are also used in automotive gasoline, diesel fuel, and related petroleum products for military applications.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Quantity required.
- c. Packaging requirements (see 5.1).

6.2.1 Amount of additive use. When Government procurement documents specify the use of these additives in fuels and related petroleum products, the concentration of the additive will be specified in grams of additive per cubic meter of fuel and will not be less than the minimum effective concentration nor more than the maximum allowable concentration as listed on the Qualified Products List. Since the additive is intended for use under many different environments, it is not possible to establish a single, optimum concentration for all uses. Therefore, when the Government does not require a specific concentration, the quantity of additive used may vary to meet specific conditions.

6.3 Material Safety Data Sheets. Contracting officers will identify those activities that require copies of completed Material Safety Data Sheets (MSDS) prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

6.4 Toxicity. Questions pertaining to toxicity should be directed to the medical service department of the procuring activity. The U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) will act as advisor to Army procuring activities. The Department of the Army Pamphlet (DA) 70-3 requires a Toxicity Clearance (approval) prior to use of a new material or chemical. Army toxicity questions and/or a Toxicity Clearance request should be addressed to: Commander, US Army Center for Promotion and Preventative Medicine (MCHB-TS-T), 5158 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5403.

6.5 Additive for addition to fuels. When a fuel contractor or the Government purchases the additive for addition to fuels to be used by the Government, the manufacturer of the additive must certify to the purchaser that the product has been qualified under this specification. In addition, a test report that shows compliance of the product with the requirements of 4.3 must be supplied to the purchaser. Additional data may be required by the Purchasing Activity to establish compliance with this specification.

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6.6 Qualification. With respect to products that require qualification, awards will be made only for products that are, at the time of award of contract, qualified for inclusion in Qualified Products List (QPL) No. 25017 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from AFPA/PTPT, 2430 C Street, Bldg 70, Area B, Wright-Patterson AFB, OH 45433-7632. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.daps.dla.mil>.

6.6.1 Qualification test report. The Qualifying Activity will request a certified test report from the independent laboratory. The test report will contain laboratory data which detail the results required by 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.11, 3.12, and 3.16. The test report will also contain laboratory data on any of the special tests conducted to qualify the additive for use in motor gasolines and diesel fuels (i.e.; 3.13, 3.14, and 3.15). In addition, complete formulation data will be supplied to the Qualifying Activity. This data will include chemical composition (I.U.P.A.C. nomenclature and structural diagrams of each ingredient), the percentages of each ingredient, the manufacturer and trade names of each ingredient, and, where available, the purity of each ingredient. The contractor will be required to furnish toxicological data and formulations necessary to evaluate the safety of the material for the proposed use.

6.7 Conversion of metric units. Units of measure have been converted to the International System of Units (Metric) in accordance with ASTM E380. If test results are obtained in units other than Metric or there is a requirement to report dual units, ASTM E380 or ASTM D1250 Volume XI/XII should be used to convert the units.

6.8 Subject term (key word) listing.

Diesel  
Fuel additive  
Gasoline  
Isopropanol  
Petroleum  
Turbine fuel

6.9 International standardization agreements. Certain provisions of this specification are the subjects of International Standardization Agreements STANAG 3390 and STANAG 1135. When amendment, revision, or cancellation of this specification is proposed which will modify the international agreement concerned, the Preparing Activity will take appropriate action through international standardization channels, including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.10 Amendment notations. The margins of this specification are marked with vertical lines to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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CONCLUDING MATERIAL

Custodians:

Army – AT  
Navy – AS  
Air Force – 68

Preparing activity:

Air Force – 68  
(Project 6850-2011-004)

Review activities:

Army – AV, MD1  
Navy – SH  
Air Force – 11  
DESC – PS  
DLA – GS

Note: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information using the ASSIST Online database at <https://assist.daps.dla.mil>.

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# EXHIBIT 46

METRIC  
MIL-PRF-32490  
03 February 2014

PERFORMANCE SPECIFICATION  
ADDITIVE, LUBRICITY IMPROVER, DIESEL

This specification is approved for use by all Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers the requirements for two grades of diesel lubricity improver additives that are used in naval distillate fuels conforming to MIL-DTL-16884.

1.2 Classification. Lubricity improver additives will be of the following grades, as specified (see 6.2).

<u>Grade</u>	<u>Description</u>
A	Standard (acceptable down to 0 °C)
B	Cold weather compatible (acceptable down to -15 °C)

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

### 2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

### DEPARTMENT OF DEFENSE SPECIFICATIONS

- MIL-PRF-2104 - Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service
- MIL-DTL-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5
- MIL-PRF-9000 - Lubricating Oil, Shipboard Internal Combustion Engine, High-Output Diesel
- MIL-DTL-16884 - Fuel, Naval Distillate
- MIL-PRF-17331 - Lubricating Oil, Steam Turbine and Gear, Moderate Service
- MIL-PRF-23699 - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Number O-156
- MIL-PRF-25017 - Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (NATO S-1747)

Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to [CommandStandards@navy.mil](mailto:CommandStandards@navy.mil), with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

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MIL-DTL-32353 - Hydraulic and Lubricating Oil, Synthetic Hydrocarbon Base

MIL-DTL-85470 - Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745

(Copies of these documents are available online at <http://quicksearch.dla.mil>.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

- ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- ASTM D97 - Standard Test Method for Pour Point of Petroleum Products
- ASTM D445 - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- ASTM D482 - Standard Test Method for Ash from Petroleum Products
- ASTM D664 - Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration
- ASTM D971 - Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method
- ASTM D1298 - Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- ASTM D2111 - Standard Test Methods for Specific Gravity and Density of Halogenated Organic Solvents and Their Admixtures
- ASTM D4052 - Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
- ASTM D4057 - Standard Practice for Manual Sampling of Petroleum and Petroleum Products
- ASTM D4176 - Standard Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)
- ASTM D5453 - Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel and Engine Oil by Ultraviolet Fluorescence
- ASTM D5949 - Standard Test Method for Pour Point of Petroleum Products (Automatic Pressure Pulsing Method)
- ASTM D5950 - Standard Test Method for Pour Point of Petroleum Products (Automatic Tilt Method)
- ASTM D5985 - Standard Test Method for Pour Point of Petroleum Products (Rotational Method)
- ASTM D6079 - Standard Test Method for Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFRR)
- ASTM D6304 - Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration

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- ASTM D7039 - Standard Test Method for Sulfur in Gasoline, Diesel Fuel, Jet Fuel, Kerosine, Biodiesel, Biodiesel Blends, and Gasoline-Ethanol Blends by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry
- ASTM D7111 - Standard Test Method for Determination of Trace Elements in Middle Distillate Fuels by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)
- ASTM D7261 - Standard Test Method for Determining Water Separation Characteristics of Diesel Fuels by Portable Separometer
- ASTM E29 - Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

(Copies of these documents are available online at <http://www.astm.org/>.)

#### DGMK GERMAN SOCIETY FOR PETROLEUM AND COAL SCIENCE AND TECHNOLOGY

- DGMK Research Report 531 - Establishing a Series of Criteria for Testing Lubricity Additives in Diesel Designed to be Used in Refineries
- DGMK Research Report 663 - Diesel Fuel Filterability

(Copies of these documents are available online at <http://www.dgmk.de/>.)

**2.4 Order of precedence.** Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

**3.1 Qualification.** The additives furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list (QPL) before contract award (see 4.2 and 6.6).

**3.1.1 Qualification requirements.** All approved additives shall meet the requirements of 3.2 through 3.8 to be qualified for use in fuels conforming to MIL-DTL-16884.

**3.1.2 Referee fuel.** Specific to this performance specification, the referee fuel shall conform to MIL-DTL-16884, shall have a high frequency reciprocating rig (HFRR) wear scar in the range of 600 to 650 micrometers ( $\mu\text{m}$ ) in accordance with ASTM D6079, and have a maximum sulfur concentration of 15 milligrams per kilogram (mg/kg). The referee fuel shall have a diesel micro-separability (DSEP) rating in accordance with ASTM D7261 equal to or greater than 90. The referee fuel shall contain no additives unless specified in this document. Samples of the referee fuel may be obtained by contacting NAVAIRSYSCOM, AIR 4.4.5.1, Bldg. 2360 PSEF, 22229 Elmer Road, Patuxent River, MD 20670-1534.

**3.2 Materials.** The composition of the finished additive is not limited, but is subject to review by the qualifying activity to ensure service compatibility with previously qualified products.

**3.3 Minimum effective concentration.** The minimum effective concentration shall be the amount of additive required to yield an average wear scar diameter equal to or less than 460  $\mu\text{m}$  in the referee fuel when triplicate HFRR tests are performed in accordance with ASTM D6079.

The minimum effective concentration will be identified by the qualifying activity and cited on the QPL.

**3.4 Maximum allowable concentration.** The maximum allowable concentration shall be the lowest of the following:

- a. One and a half times the minimum effective concentration.
- b. The highest concentration that results in less than a 10-percent change in diesel micro-separability when tested in accordance with 4.4.6.1.

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- c. The highest concentration that will pass all requirements of 3.6.

The maximum allowable concentration will be identified by the qualifying activity and cited on the QPL.

**3.5 Chemical and physical properties.** The additive shall conform to the chemical and physical properties outlined in [table I](#). To determine conformance to the specification requirement, a test result may be rounded to the same number of significant figures as in [table I](#) using ASTM E29. Where multiple determinations are made, the average result, rounded in accordance with ASTM E29, shall be used.

TABLE I. Chemical and physical properties.

Characteristic	Requirement Grade A	Requirement Grade B, Cold Weather Compatible	ASTM Test Method
Appearance at 25 °C	Clear and Bright, Free of Visible Particulates or Water	Clear and Bright, Free of Visible Particulates or Water	D4176 (Procedure 1)
Flash Point, °C (min)	60	60	D93
Viscosity, at -20 °C, mm <sup>2</sup> /second (max)	—	400	D445
Viscosity, at 0 °C, mm <sup>2</sup> /second (max)	400	—	D445
Water Content, mg/kg (max)	3000	3000	D6304
Ash Content, wt. % (max)	0.10	0.10	D482
Sulfur Content, mg/kg (max)	15	15	D5453, D7039

### **3.6 Performance characteristics.**

**3.6.1 Solubility.** Twice the minimum effective concentration of additive, as defined in 3.3, shall be readily and completely soluble in the fuel for which it is qualified. There shall be no precipitation or cloudiness when tested as specified in 4.4.1.

**3.6.2 Compatibility.** The candidate additive shall be compatible with all those currently qualified under this specification (see 4.4.2.1), in addition to static dissipater additives, ignition improver additives, middle distillate flow improver additives, anti-oxidants, aviation corrosion inhibitor/lubricity improver additives, and fuel system icing inhibitor as prescribed in 4.4.2.2. The candidate additive shall also be tested for compatibility with the Navy's current shipboard lubricants as specified in 4.4.2.3. There shall be no precipitation, cloudiness, or color change when tested as specified in 4.4.2.

**3.6.3 Impact on fuel properties.** The blend of the additive in the referee fuel at twice the minimum effective concentration as defined in 3.3 shall meet all of the applicable requirements for MIL-DTL-16884 when tested in accordance with 4.4.3. Additionally, all properties, except lubricity at 60 °C, shall not change more than the prescribed ASTM method repeatability as compared to the referee fuel. Properties that change greater than the ASTM method's repeatability may be accepted at the discretion of the qualifying activity.

**3.6.4 Storage stability.** After being stored for 12 months in accordance with 4.4.4, the additive shall show no precipitation, color change, stratification, or cloudiness.

**3.6.5 Temperature stability.** The additive shall show no precipitation, color change, stratification, cloudiness, or other indication of degradation after being subjected to the temperature stability protocol (see 4.4.5).

**3.6.6 Water separation.** The additive, when blended at twice its minimum effective concentration in the referee fuel, shall have no significant effect on the water separation of the fuel, as defined below, when tested in accordance with 4.4.6.

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3.6.6.1 Diesel micro-separability (DSEP). The candidate additive, when blended at twice its minimum effective concentration in the referee fuel, shall not vary by more than 10 percent from the DSEP rating, ASTM D7261, of referee fuel when tested in accordance with 4.4.6.1. To calculate this variation, the referee fuel shall be tested in accordance with ASTM D7261 concurrently to define the actual DSEP value without the presence of the lubricity improver additive. The referee fuel shall have a DSEP rating equal to or greater than 90.

3.6.6.2 Interfacial tension. The interfacial tension of the candidate additive, when blended at twice its minimum effective concentration in the referee fuel, shall be no less than 20 dyne/centimeter when tested in accordance with 4.4.6.2.

3.6.7 Naval coalescence test (NCT). If the referee fuel, when additized to twice the minimum effective concentration, has 4 or more consecutive hours demonstrating poor coalescence, where the downstream free water concentration is 100 mg/kg or greater than that of the saturated fuel tanks, then the additized fuel under test shall be deemed a failure in accordance with 4.4.7.

3.6.8 Toxicity. When evaluated in accordance with 4.4.8 [the Health Hazard Assessment (HHA)], the additive shall have no adverse effect on the health of personnel when used for its intended purpose (see 4.4.8 and 6.5).

3.7 Identification of qualification data. The following properties of the finished additive shall be determined during qualification, but not limited to: density at 15 °C, metallic constituents, and total acid number (see 4.5). The permissible minimums and maximums of individual properties due to production variation shall be established at the time of qualification. Individual batches of additive subsequently subjected to qualification conformance inspections shall conform to the established minimums and maximums of properties. The minimums and maximums of individual properties shall not adversely affect any of the additive performance characteristics.

3.8 Workmanship. The finished additive in bulk or container shall be uniform in appearance in accordance with [table I](#), clear and bright, and visually free from grit, un-dissolved water, insoluble components, and other foreign matter.

#### 4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Conformance inspection (see 4.3).

4.2 Qualification inspection. Qualification tests shall be conducted at a laboratory acceptable to the Naval Sea Systems Command (NAVSEA). Qualification inspection shall be performed in accordance with the test conditions specified in [table II](#) and 4.4.

4.2.1 Qualification sampling. Unless otherwise specified by NAVSEA, an initial 3.78-liter (1-gallon) sample of finished additive shall be submitted for evaluation of all the tests required in 3.3 through 3.6.3, 3.6.5, 3.6.6, and 3.8 to an independent laboratory acceptable to NAVSEA. If the additive passes all the tests, an additional sample of finished additive consisting of two 1-liter aliquots shall be required for the storage stability test (see 3.6.4). These additional samples shall be identified as such and forwarded to NAVSEA (see 6.6). Upon request, samples of finished additive shall also be submitted for NCT evaluation (see 3.6.7) to the qualifying activity.

4.2.2 Change approval. Any change in formulation, ingredients, manufacturing processes, or manufacturing locations of the additive shall be approved by NAVSEA. Incorporation of any changes, which have not been so approved, shall require requalification of the item in question.

4.2.2.1 Requalification. Unless otherwise approved by NAVSEA, requalification shall consist of the tests specified in 4.4.

4.3 Conformance inspection. Conformance inspection of a bulk lot, prior to becoming a packaged lot, of additive shall consist of tests for conformance to the requirements in 3.5 and 3.7 as listed in [table II](#).

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TABLE II. Qualification tests and conformance inspections.

Tests	Requirement	Qualification Test	Conformance Test
Chemical and Physical Properties	3.5	<a href="#">Table I</a>	<a href="#">Table I</a>
Solubility	3.6.1	4.4.1	
Compatibility	3.6.2	4.4.2	
Impact on Fuel Properties	3.6.3	4.4.3	
Storage Stability	3.6.4	4.4.4	
Temperature Stability	3.6.5	4.4.5	
Diesel Micro-Separability	3.6.6.1	4.4.6.1	
Interfacial Tension	3.6.6.2	4.4.6.2	
NCT	3.6.7	4.4.7	
Toxicity	3.6.8	4.4.8	
Identification Qualification Data	3.7	4.5	4.5

#### 4.3.1 Inspection lots.

4.3.1.1 Bulk lot. A bulk lot is defined as an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single, isolated container manufactured through the same processing equipment with no change in ingredient material.

4.3.1.2 Packaged lot. A packaged lot is defined as an indefinite number of 208-liter (55-gallon) drums or smaller unit packages of identical size and type, or an indefinite number of 2080-liter (550-gallon) or less returnable containers, such as totes, offered for acceptance and filled with a homogenous mixture of material from a bulk lot.

4.3.2 Sampling. Each bulk or packaged lot of material shall be sampled for verification of product quality and compliance in accordance with ASTM D4057.

#### 4.4 Methods of inspection.

4.4.1 Solubility. The additive shall be mixed with the referee fuel, at twice its minimum effective concentration, and then stored in a sealed, clear glass bottle at 25 °C in the dark. Samples shall be visually inspected for precipitation, cloudiness, or color change both before (at ambient temperature) and after being stored at 25 °C in the dark for 24 hours.

#### 4.4.2 Compatibility.

4.4.2.1 Additional QPL additives. The referee fuel that contains twice the minimum effective concentration of the candidate additive and no other additives shall be mixed in equal proportions with samples of the referee fuel which contains twice the minimum effective concentration of the individual additives currently on the QPL for this specification and then stored in a sealed, clear glass bottle at 25 °C in the dark for 24 hours. At the end of a 24-hour period, the sample shall be visually inspected for precipitation, cloudiness, or color change.

4.4.2.2 Other additives. The candidate additive shall also be evaluated for compatibility with other additives commonly seen in fuels used by the Navy. The candidate additive shall be blended with the referee fuel at four times its minimum effective concentration, in addition to the additives and concentrations specified below.

Step 1. A 250- milliliter (mL) sample of the referee fuel with candidate additive at four times its minimum effective concentration and containing no other additives shall be prepared in a clear glass container (control sample). After additization, the sample shall be split equally into two samples in clear glass containers.

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**Step 2.** A 250-mL sample shall be prepared in a clear glass container of the referee fuel with candidate additive at four times its minimum effective concentration and containing the following additives at the specified concentration:

- a. One approved anti-oxidant in accordance with the formulation requirements of MIL-DTL-5624, 48 milligrams per liter (mg/L).
- b. N,N'-disalicylidene-1,2-propanediamine (metal deactivator additive), 11 mg/L.
- c. One corrosion inhibitor/lubricity improver at a concentration of twice the maximum allowable limit as specified in MIL-PRF-25017.
- d. Fuel system icing inhibitor in accordance with MIL-DTL-85470 at a concentration of twice the maximum limit for Grade JP-5 as specified in MIL-DTL-5624.
- e. Static dissipater additive, in accordance with the requirements of MIL-DTL-5624, 10 mg/L.
- f. 2-ethylhexyl nitrate (cetane improver), 0.8-percent volume.

After additization, the sample shall be split equally into two samples in clear glass containers.

**Step 3.** One of the control samples from Step 1 and one of the additized fuel samples from Step 2 shall be placed into dark, cold storage at 0 °C for 24 hours. At the end of the 24 hours, the samples shall be removed from cold storage and immediately inspected for indication of precipitation, cloudiness, or color change. The samples shall be allowed to passively warm to ambient room temperature (15 °C to 25 °C) and again inspected for indication of precipitation. The second inspection shall take place no more than 1 hour after reaching ambient room temperature.

**Step 4.** The other control sample from Step 1 and other additized fuel from Step 2 shall be placed into dark, heated storage at 38 °C and the temperature shall be maintained for 24 hours. This step may be run concurrently with Step 3. At the end of the 24 hours, the samples shall be allowed to cool to ambient room temperature (15 °C to 25 °C). The samples shall be inspected for indication of precipitation, cloudiness, or color change.

**Step 5.** If incompatibility is documented at any point during the procedure, it is acceptable to repeat Steps 1 through 4 by testing individual additives for compatibility one at a time rather than mixing all of the additives into one sample.

NOTE: All samples shall be stored in the dark during conditioning and between inspections.

**4.4.2.3 Lubricant oils.** The candidate additive shall be tested for compatibility with the Navy's current shipboard lubricants: MIL-PRF-23699, MIL-PRF-9000, MIL-PRF-2104, MIL-PRF-17331, MIL-DTL-32353, Shell Gadolinia or other commercial equivalent approved by NAVSEA, and Mobil Delvac 1640 or other commercial equivalent approved by NAVSEA. Samples of these lubricants may be obtained by contacting NSWCCD Philadelphia, Code 615, Philadelphia, PA, 19112. The referee fuel and candidate additive shall be tested in accordance with the test procedure in Section I-A of DGMK Research Report 531. This test shall be conducted twice, once using the specified filter material and again using the filter material specified in DGMK Research Report 663. Acceptance criteria for the testing shall be in accordance with section I-A.7 of DGMK Research Report 531. Test results for the two filter media will be assessed independently in the determination of additive acceptance (passing performance), recognizing that some lubricity additives may interact with filter media leading to erroneous test results. Both test procedures will be individually repeated for all six lubricant oils; however, all six test samples may be stored concurrently. Final inspection shall take place no more than 1 hour after reaching ambient room temperature.

**4.4.3 Impact on fuel properties.** Fuel properties of the referee fuel containing twice the minimum effective concentration of the candidate additive shall be measured as specified in MIL-DTL-16884.

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**4.4.4 Storage stability test.** Two 1-liter or 1-quart clear glass bottles shall each be filled with 850 mL of the candidate additive and shall be tightly capped by means of a screw cap that has a conical polyethylene liner. Each bottle shall be wrapped in a minimum amount of opaque packing materials sufficient for protection against mechanical damage, but minimal in thermal insulation qualities. The wrapped bottles shall be enclosed in a tight wooden or metal box for further protection against breakage and sunlight. The crated samples shall be stored at ambient outdoor conditions at Naval Air Station Patuxent River, Maryland. The box shall be kept off the ground and protected from direct sunlight and precipitation under a canopy, open shed roof, or similar ventilated shelter. The crated samples shall be stored undisturbed in an upright position. One of the samples shall be stored for exactly 12 months and then removed for examination and testing; the other sample shall be stored for 12 months or less and may be removed for examination and testing at any time, at the option of the qualifying activity. Whenever a sample is removed for examination and testing, it shall be uncrated with minimum disturbance; the bottle shall not be shaken, inverted, or otherwise agitated. The top half of the contents of the bottle shall be visually inspected for precipitation or separation into layers. Candidate additive shall be tested for conformance to properties in [table I](#).

**4.4.5 Temperature stability protocol.** For procedures specifying a lowest temperature, 0 °C and -15 °C shall be used for Grades A and B, respectively. Each sample bottle shall be wrapped in a minimum amount of opaque packing materials sufficient for protection against mechanical damage, but minimal in thermal insulation qualities. For temperature stability test protocols, 4.4.5.1 through 4.4.5.4, the sample shall be stored in a dark environment and shall not be shaken, inverted, or otherwise agitated during testing and inspection.

**4.4.5.1 Stability at low temperature.** Two 100-mL samples of the test additive shall then be cooled to 0 °C for Grade A (one of the samples) and -15 °C for Grade B (the second sample) and held for 1 week. For passing additives, the test samples may be returned to their respective temperatures for continued aging to assess the robustness of the passing additive candidate. The test additive shall be inspected immediately out of cold soak and found free of precipitation and gelling.

**4.4.5.2 Cold/heat cycling.** A 100-mL sample of the candidate additive shall be held at the temperature conditions defined in 4.4.5 for 16 hours, removed from the cold chamber, and held at ambient room temperature (15 °C to 25 °C) for 8 hours, inspected for any precipitation and gelling, then placed back in the cold chamber. This process shall be repeated three times.

**4.4.5.3 Stability at elevated temperatures.** A 100-mL sample of candidate additive shall be stored at 38 °C for 6 weeks. Every week the sample shall be checked for precipitation, cloudiness, color change, or other indication of degradation. For passing additives, the test samples may be returned to their respective temperatures for continued aging to assess the robustness of the passing additive candidate.

**4.4.5.4 Freeze/thaw cycling.** The candidate additive pour point shall be measured in accordance with ASTM D97, ASTM D5949, ASTM D5950, or ASTM D5985. A room temperature, homogeneous sample of the candidate additive shall be placed into a cold chamber/liquid bath set to 3 °C lower than the measured pour point. The sample shall be held at this temperature for 1 hour, then the candidate additive sample shall be removed from cooling, and allowed to warm at room temperature (15 °C to 25 °C) until solid crystals are no longer visible in the sample. The additive shall be checked for stratification and permanent separation. This process shall be repeated three times.

#### **4.4.6 Water separation.**

**4.4.6.1 Diesel micro-separometer rating (DSEP).** The candidate additive, at twice its minimum effective concentration, shall be blended into the referee fuel and DSEP shall be tested in accordance with ASTM D7261. The referee fuel without the candidate additive shall also be tested.

**4.4.6.2 Interfacial tension.** The test additive, at twice its minimum effective concentration, shall be blended into the referee fuel and interfacial tension shall be tested in accordance with ASTM D971.

**4.4.7 NCT.** The NCT is a Navy-unique coalescence test rig. The NCT shall be operated in accordance with the operating requirements specified in Appendix A. The referee fuel shall contain twice the minimum effective concentration of the candidate additive.

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**4.4.8 Toxicity.** An HHA shall be conducted to ensure conformance to 3.6.8, as required by the qualifying activity. The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the additive using the administrative HHA data provided by the manufacturer/distributor to the NMCPHC.

**4.5 Identification tests.** Identification tests of the finished additive shall be conducted in accordance with the following methods:

- a. Density at 15 °C – ASTM D1298, ASTM D2111, or ASTM D4052.
- b. Metallic constituent – ASTM D7111 (Emission spectrograph, not applicable for materials with ash contents of 0.05 weight percent or lower).
- c. Total acid number – ASTM D664.
- d. Sulfur – ASTM D5453 or ASTM D7039 (maximum concentration 15 mg/kg).

## 5. PACKAGING

**5.1 Packaging.** For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

**6.1 Intended use.** The additives covered by this specification are used, when specifically authorized, in F-76 fuels conforming to MIL-DTL-16884 to improve the lubricating qualities when required.

**6.2 Acquisition requirements.** Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Grade (see 1.2).
- c. Quantity required.
- d. Packaging requirements (see 5.1).

**6.2.1 Amount of additive use.** When Government procurement documents specify the use of these additives in fuels and related petroleum products, the concentration of the additive should be specified in grams of additive per cubic meter of fuel and should not be less than the minimum effective concentration nor more than the maximum allowable concentration as listed on the QPL. Since the additive is intended for use under many different environments, it is not possible to establish a single, optimum concentration for all uses. Therefore, when the Government does not require a specific concentration, the quantity of the additive used may vary to meet specific conditions.

**6.3 Additive for addition to fuels.** A test report that shows compliance of the product with the requirements of 4.3 should be supplied to the purchaser. Additional data may be required by the purchasing activity to establish compliance with this specification.

**6.4 Material safety data sheets (MSDSs).** Contracting officers should identify those activities that require copies of complete MSDSs prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

**6.5 Toxicity.** The Navy and Marine Corps Public Health Center (NMCPHC) requires sufficient information to permit an HHA of the product. Upon completion of the HHA, a copy will be provided by the NMCPHC to the Government for evaluation.

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**6.6 Qualification.** With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 32490 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to [CommandStandards@navy.mil](mailto:CommandStandards@navy.mil). An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

**6.6.1 Qualification test report.** The qualifying activity will request a certified test report from the independent laboratory. The test report should contain laboratory data which detail the results required by 3.3 through 3.8. In addition, complete formulation data should be supplied to the qualifying activity. This data should include chemical composition (International Union of Pure and Applied Chemistry [IUPAC] nomenclature and structural diagrams of each ingredient), the percentages of each ingredient, the manufacturer and trade names of each ingredient, and, where available, the purity of each ingredient. The contractor will be required to furnish toxicological data and formulations necessary to evaluate the safety of the material for the proposed use.

**6.6.2 Provisions governing qualification.** Copies of SD-6, "Provisions Governing Qualification", are available online at <http://quicksearch.dla.mil/> or <https://assist.dla.mil>.

**6.7 Conversion of metric units.** Units of measure have been converted to the International System of Units (metric) in accordance with ASTM E380. If test results are obtained in units other than metric, or there is a requirement to report dual units, ASTM E380 or, in the case of volume measurements, ASTM D1250 Volume XI/XII should be used to convert the units.

**6.8 Shelf-life.** This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123, preparation of a materiel quality storage standard for Type II (extendible) shelf-life items, and a minimum of 85 percent shelf-life remaining at time of receipt by the Government. These and other requirements, if necessary, are in DoD 4140.27-M, Shelf-life Management Manual. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points that manage the item and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website at <https://www.shelflife.hq.dla.mil/>.

**6.9 Subject term (key word) listing.**

Qualification testing

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APPENDIX A

## NAVAL COALESCENCE TEST (NCT)

## A.1 SCOPE

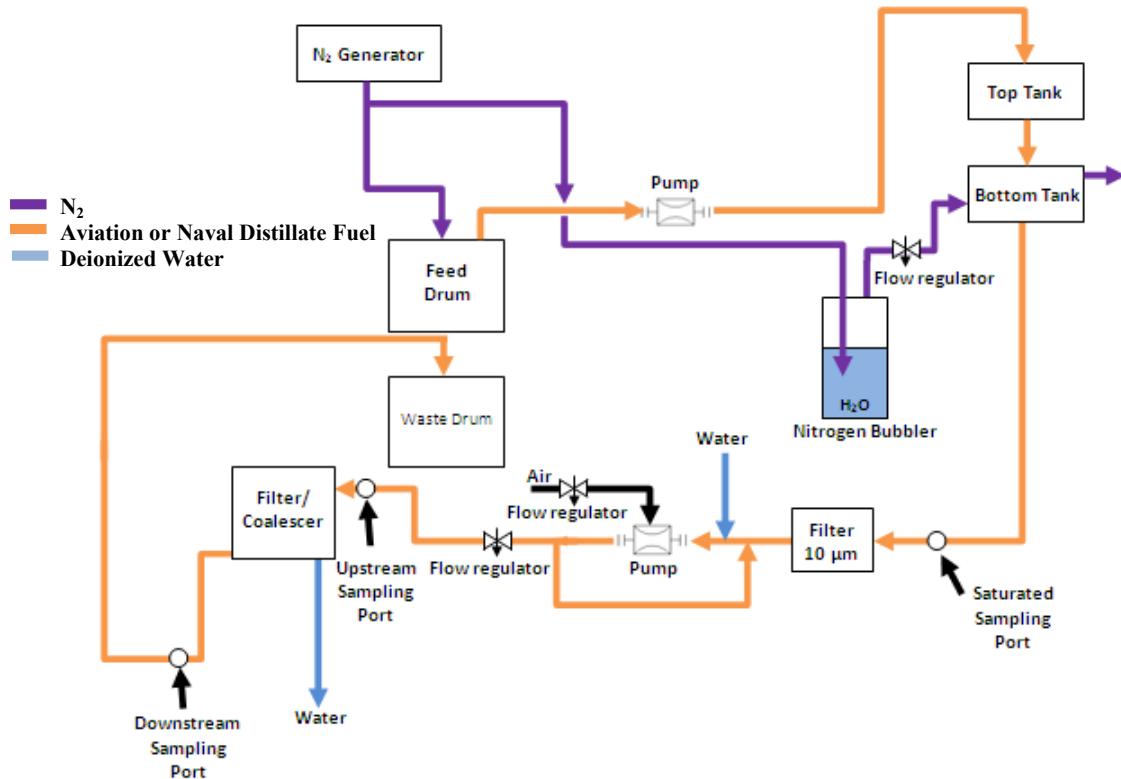
A.1.1 Scope. This appendix outlines the protocol used to simulate water coalescence effects in aviation and naval distillate fuels. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.1.2 Summary of the method. The NCT is a fit-for-purpose test, which allows for fuel flow through a fuel coalescer while using a small amount of fuel. The objective of this test is to determine the water shedding, or coalescence properties, of the candidate additive on the filter. A known amount of free (undissolved) water will be injected upstream of the test element and upstream and downstream free and dissolved (total) water levels will be measured and compared to the saturated water level in the fuel. A passing test shall give downstream free water measurements that are comparable to that of the saturated water level of the fuel.

## A.2 MATERIALS AND APPARATUS

A.2.1 Apparatus. The test apparatus is shown schematically in [figure A-1](#). It consists of the following:

- Nitrogen sparger
- Test capsule
- Syringe pump
- Control system and panel
- Localized valves, including the rotameter control valve, fuel feed valves, discharge valves, and air supply valve

FIGURE A-1. NCT schematic.

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**APPENDIX A**

**A.2.2 Materials.** The materials shall consist of the following:

- a. 378 liters (100 gallons) of referee fuel with candidate additive
- b. Latex gloves
- c. Syringes, 1 mL and 50 mL
- d. Solvent dispenser squeeze bottle, 500 mL
- e. Graduated cylinder, 500 mL
- f. Water injection needle, #33
- g. Tweezers, flat tipped
- h. Distilled water

#### **A.3 TEST PROCEDURE**

**A.3.1 Test preparation.** A new, epoxy/phenolic lined 208-liter (55-gallon) drum is filled with filtered test fuel. A steel 8-inch extender tube is attached to the large bung of the drum and a stainless steel, air driven pump is placed into the extender tube. The drum pump outlet line is then attached onto the 90-degree stainless steel fitting on the small bung of the drum and the additized referee fuel is recirculated through the drum pump at 26.5 liters per minute (7 gallons per minute) for 3 hours. If no flowmeter is available, then the air on the pump is turned halfway on and then slowly closed until the flow contains no bubbles. The inlet and outlet drum lines are then attached to the portable filter separator apparatus and the additized referee fuel is recirculated for 16 hours. Finally, a 3.78-liter (1-gallon) sample of additized referee fuel is collected and submitted to a laboratory for filtration time and particulate matter analysis.

**A.3.2 Test operation.** The NCT shall be cleaned and built up prior to running each additized fuel and a new NCT element shall be inserted into the capsule holder prior to beginning a new test. The separator is tested for water beading efficiency, and the system is flushed with additized referee fuel for 60 minutes. The nitrogen generator must be properly configured and distilled water shall be filled to the 800-mL mark in the 1000-mL graduated cylinder nitrogen sparger. The injection needle is inspected and the fuel flow set to 33 mL/minute. The water injection valve is then opened and observed until water drops appear at the outlet of the filter separator. Time is recorded as soon as the first drop is seen. The syringe pump is set to approximately 8.25 µL/minute and the fuel flow is maintained at 33 mL/minute using the appropriate valves. This results in an undissolved water concentration of 250 mg/kg in the test fuel. Normal test duration is 80 hours. The following shall be collected:

- a. The inlet total water content shall be measured, in triplicate, in accordance with ASTM D6304, once per hour from a sample obtained from upstream sampling port.
- b. The outlet total water content shall be measured, in triplicate, in accordance with ASTM D6304, once per hour from a sample obtained from downstream sampling port.
- c. The total water content shall be measured, in triplicate, in accordance with ASTM D6304, once per hour by extracting a sample from the saturated water port. Differential pressure across the filter/separator and fuel temperature shall be recorded every hour. Accumulated water in the housings shall be drained and bled off as needed, and documentation shall continue for 80 test hours.

#### **A.4 DATA EVALUATION**

**A.4.1 Acceptance criteria.** The test shall be considered passing if the difference between the outlet total water concentration and saturated total water concentration does not exceed 100 mg/kg for 4 consecutive hours. A differential pressure across the filter/separator shall remain less than 3 pounds per square inch (psi) during the entire 80-hour test.

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Custodians:

Army – AT  
Navy – SH  
Air Force – 68

Preparing activity:

Navy – SH  
(Project 6850-2013-007)

Review activities:

Army – AV, CR4, EA, MI, MR  
Navy – AS, CG, MC  
Air Force – 11, 99  
DLA – PS  
NGA – MP

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.

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UNITED STATES DISTRICT COURT  
NORTHERN DISTRICT OF CALIFORNIA  
SAN FRANCISCO DIVISION

CITY OF OAKLAND, a Municipal Corporation, and THE PEOPLE OF THE STATE OF CALIFORNIA, acting by and through Oakland City Attorney BARBARA J. PARKER

Plaintiffs,

v.

BP P.L.C., a public limited company of England and Wales; CHEVRON CORPORATION, a Delaware corporation; CONOCOPHILLIPS COMPANY, a Delaware corporation; EXXON MOBIL CORPORATION, a New Jersey corporation, ROYAL DUTCH SHELL PLC, a public limited company of England and Wales, and DOES 1 through 10,

Defendants.

CITY AND COUNTY OF SAN FRANCISCO, a Municipal Corporation, and THE PEOPLE OF THE STATE OF CALIFORNIA, acting by and through the San Francisco City Attorney DENNIS J. HERRERA,

Plaintiffs,

v.

BP P.L.C., a public limited company of England and Wales, CHEVRON CORPORATION, a Delaware corporation, CONOCOPHILLIPS COMPANY, a Delaware corporation, EXXONMOBIL CORPORATION, a New Jersey corporation, ROYAL DUTCH SHELL PLC, a public limited company of England and Wales, and DOES 1 through 10,

First-Filed Case No. 3:17-cv-6011-WHA  
Related to Case No. 3:17-cv-6012-WHA

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Defendants.

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### **DECLARATION OF RICHARD TYLER PRIEST**

1. My name is Richard Tyler Priest. I am over eighteen (18) years of age. I have personal knowledge of the facts set forth in this declaration and am competent to testify to them if necessary.

2. Since 2012, I have been Associate Professor of History and Geographical and Sustainability Sciences at the University of Iowa. From 2004 to 2012, I was Clinical Professor and Director of Global Studies at the C.T. Bauer College of Business, University of Houston. In 2010-2011, I served as Senior Policy Analyst with the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. My primary interests are in the fields of energy and environmental history. I also work and teach in the related areas of global history, history of business and technology, and public history.

3. I am being compensated at the hourly rate of \$400.00 for my work on this matter.

4. I received my Ph.D. in History from the University of Wisconsin-Madison in 1996. My scholarly work investigates the history of oil and energy, and the

main thrust of my research examines the history of offshore oil and gas. My publications include the co-authored, *Offshore Pioneers: Brown & Root and the History of Offshore Oil and Gas* (Gulf Publishing, 1997), and the book, *The Offshore Imperative: Shell Oil's Search for Petroleum in Postwar America* (Texas A&M Press). My research on offshore petroleum evolved into a long-range effort to preserve, document, and analyze the history of the offshore industry in the Gulf Coast region. I have served as chief historian on three interdisciplinary and collaborative research projects sponsored by the Department of Interior's Minerals Management Service (since 2011, the Bureau of Ocean Energy Management, or BOEM).

### **Scope of Assignment**

5. I have been retained by Chevron to conduct historical research and provide historical analysis on the role of the U.S. federal government in oil and gas exploration, development, and operations on the U.S. Outer Continental Shelf.

6. I and/or research assistants working at my direction have conducted research in public documents and public and/or business records normally relied on by experts in my field. The materials consulted and/or cited in this declaration were obtained from various libraries, archives, and other repositories, including,

but not limited to, the National Archives and Records Administration in College Park, Maryland; the Louisiana Research Collection, Tulane University; the Kansas Collection, University of Kansas Libraries; the American Heritage Center, University of Wyoming; published government records; and other digitally accessible sources. Collected and cited documents include primary source materials contemporaneous with government and industry actions and policies at issue here as well as secondary sources. Should additional relevant information become available to me, I may revise and/or supplement this declaration.

### **Findings Summary**

7. The collection and analysis of the materials identified was conducted using an established historical methodology for inquiries of this type. My findings are based on the body of information available to date. My findings emphasize two main themes:

- (1) For more than six decades, the U.S. federal Outer Continental Shelf (OCS) program<sup>1</sup> filled a national government need. It procured the

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<sup>1</sup> From 1954 to 1982, the Bureau of Land Management (BLM) and the U.S. Geological Survey's Conservation Division within the Department of the Interior were the lead agencies in the federal OCS program. These agencies were

services of oil and gas firms to develop urgently needed energy resources on federal offshore lands that the federal government was unable to do on its own. The federal OCS program created a secure, domestic source of oil and gas to help meet growing U.S. demand during many years of heightened and recurring geopolitical crises that made reliance on foreign sources precarious. Oil and gas production during this period also generated substantial revenues for the federal treasury. Between 1954 and 2016, the Department of the Interior held 173 auctions to lease federal lands on the U.S. OCS, the official designation for submerged federal lands located beyond three miles (in most places) of the coastline. In these lease sale auctions, the government issued contracts for more than a total of 162

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combined in 1982 to form the Minerals Management Service (MMS). In 2010, the MMS was reorganized briefly into the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). In 2011, Interior split BOEMRE into three independent agencies that then reported to the Assistant Secretary for Land and Minerals Management: the Bureau of Ocean Energy Management (BOEM), which handles leasing and environmental assessment; the Bureau of Safety and Environmental Enforcement (BSEE), which regulates and inspects offshore operations, and the Office of Natural Resource Revenue (ONRR), which collects and manages mineral revenues. In addition to the DOI offices, there are many others in the federal government that historically have had a hand in enforcing various laws that apply offshore. These include the National Oceanographic and Atmospheric Administration (NOAA), the Coast Guard, the Federal Energy Regulatory Commission, the U.S. Department of Defense, Homeland Security, the Environmental Protection Agency, the Pipeline and Hazardous Materials Safety Administration, the Army Corps of Engineers, and the Fish and Wildlife Service.

million acres, 89 percent of which were in the Gulf of Mexico. Commercial production from offshore leases totaled more than 20 billion barrels of oil and nearly 175 trillion cubic feet of natural gas—most of it, again, from the Gulf. The federal OCS program has also been a major source of revenue for the United States. From 1954 to 2016, the federal government collected an estimated \$80 billion in signature bonuses and \$150 billion in royalties—not adjusted for inflation—from offshore oil and gas leases.<sup>2</sup> In 2010, the industry created \$44 billion in annual GDP, deposited \$8–10 billion a year in the federal treasury, and directly supported 230,000 relatively high-paying jobs, one-third of which were outside the Gulf region.<sup>3</sup> These numbers indicate not merely commercial transactions between the federal government and the oil companies. They reflect the creation of a valuable national security asset for the United States over time. As much as the extraction of oil from the ocean was the result of extraordinary technological innovation,

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<sup>2</sup> U.S. Department of the Interior, Bureau of Ocean Energy Management, Production Information, <https://www.data.boem.gov/Main/Production.aspx>, and Outer Continental Shelf Lease Sale Statistics, <https://www.boem.gov/Outer-Continental-Shelf-Lease-Sale-Statistics/>; Office of Natural Resource Revenue, Statistical Information, <https://statistics.onrr.gov/ReportTool.aspx>.

<sup>3</sup> IHS Global Insight and IHS CERA, “Restarting the ‘Engine’ – Securing American Jobs, Investment, Energy Security: The Importance to the U.S. Economy of Restarting the Offshore Oil and Gas Exploration and Development Industry” (August 2011), ES-1.

it was also a political and policy-driven project to incorporate ocean space and the OCS into the nation’s public lands and manage OCS resources in the long-term interest of U.S. energy security.

(2) The federal government directed operations on the OCS as more than merely a disinterested landowner and for purposes beyond monetary gain. The federal OCS program created an expanding market for offshore oil and gas and actively managed leases and operations to fulfill a critical national need for domestic energy. As Supreme Court Justice Hugo Black put it, the federal government’s rights on the OCS transcended those of a “mere property owner” or rentier. In promoting the expansion of offshore oil and gas drilling, production, and transportation, the federal government supervised the OCS in a way that cultivated a special relationship with oil and gas firms, but which was not driven by the particular business interests of those firms. Federal OCS governance involved establishing rights to public resources, enforcing competition among private entrants to the public mineral estate, protecting high-cost offshore exploration from foreign competition, and collecting and allocating public revenues. In doing so, federal officials also exercised their responsibilities as public trustees toward non-producers of the resource and as guardians of national interests. The

policies and plans of the federal OCS program did not always align with those of oil firms interested in drilling offshore. Federal officials viewed these firms as agents of a larger, more long-range energy strategy to increase domestic oil and gas reserves. Officials enlisted offshore oil operators as partners in creating the leasing system, formulating regulations, developing advanced technology, and cultivating the growth of a specialized offshore services sector. But the federal government dictated the terms, locations, methods, and rates of hydrocarbon production on the OCS. The ultimate objective of federal officers was to conserve those resources in the economic and security interests of the federal government, the resource owner and lessor.

### **The Legal and Administrative Foundation of the Federal OCS Program**

8. At least until 1937, congressional and executive policy in the United States assumed that individual states held property title out to three miles from the coastline in the ocean, the limit of national jurisdiction recognized by most nations under international law. In the summer of 1937, Secretary of the Interior Harold Ickes began to revise federal policy to challenge state claims to offshore submerged lands. During a period of depression and international crisis, this

challenge was driven by a nationalistic desire to appropriate revenues from offshore leasing for the federal treasury, protect strategic petroleum resources from predatory state policies and foreign suitors, and assert greater control over the oil industry. In 1933, President Franklin Roosevelt had appointed Ickes as “Oil Administrator” under the National Recovery Administration (NRA). Although the Supreme Court declared the NRA unconstitutional in 1935, the Connelly Hot Oil Act and creation of the Interstate Oil Compact Commission gave the federal government a greater role in imposing production restrictions on American oil wells. Roosevelt and Ickes were determined to extend that control to oil production under “submerged lands” offshore. In May 1937, with war clouds forming around the world, Roosevelt “raised the question [with Ickes] as to the ownership of oil found under the ocean but within the three-mile limit.”<sup>4</sup> A year later, Roosevelt suggested issuing an executive order to set up “naval oil reserves on the coast beginning with the shoreline and extending halfway across the oceans.”<sup>5</sup>

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<sup>4</sup> Harold L. Ickes, *The Secret Diary of Harold L. Ickes: Volume II, The Inside Struggle, 1936-1939* (New York: Simon and Schuster, 1954), 127.

<sup>5</sup> Nathan R. Margold, Solicitor, Department of the Interior, Memorandum for the First Assistant Secretary, September 16, 1938, Admin-Submerged Lands, 1/26/37-12/23/38, General Land Office (GLO), Central Classified Files (CCF) 1937-53, Box 3278, Record Group (RG) 48, Records of the Office of the Secretary of the Interior, U.S. National Archives and Records Administration, College Park, MD.

9. During the Second World War, Harold Ickes' tactical views on the "tidelands" dispute with the states hardened from a willingness to await a legal or legislative resolution to advocating for an executive pronouncement claiming national control over the continental shelf. In May 1943, the Interior Department's General Land Office submitted a memorandum to the secretary, pointing out the wartime opportunity to eliminate "from our thinking and international law the shackles of the three-mile limit for territorial waters," and advising that the United States adopt a "line of 100 or 150 miles from our shores" extending U.S. territory "beyond the continental shelf and reserving this valuable asset for the United States."<sup>6</sup>

10. At the end of the war, President Harry Truman carried out Roosevelt's and Ickes' plan to assert federal power over the continental shelf. On September 28, 1945, he issued Proclamation 2667, which stated that the "Government of the United States regards the natural resources of the subsoil and seabed of the continental shelf beneath the high seas but contiguous to the coasts of the United States as appertaining to the United States, subject to its jurisdiction and control." The same day, Truman signed Executive Order 9633 reserving and placing certain

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<sup>6</sup> C.E. Jackson, F.W. Lee, I.D. Wolfsohn, General Land Office, Memorandum to Secretary of the Interior, May 28, 1943, General Land Office (GLO), Admin-Submerged Lands, Central Classified Files (CCF) 1937-53, RG 48.

resources of the continental shelf under management of the secretary of the interior.<sup>7</sup> Representing the boldest step so far in the construction of marine territory as national territory, Truman's proclamation and executive order were the culmination of federal efforts beginning in the late 1930s to establish government supremacy over resources in submerged lands off the U.S. coast for the protection of national defense and the national economy.<sup>8</sup>

11. Immediately after issuing the proclamation, Truman ordered Attorney General Tom Clark to file an original action against the State of California in the U.S. Supreme Court, challenging the state's right and title in submerged lands below the low-water mark. The Court ruled in the case on June 23, 1947. Considering the larger context at that moment in time is important to understanding the majority thinking in *U.S. v. California*. The world was in geopolitical and economic crisis. The Supreme Court justices' first conference took place five days after the dramatic "Truman Doctrine" speech to a joint session

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<sup>7</sup> Harry S. Truman, "Presidential Proclamation No. 2667, Concerning the Policy of the United States with Respect to the Natural Resources and Subsoil and Sea-Bed of the Continental Shelf of 28 September 1945," 10 *Federal Register (Fed. Reg.)* 193 (October 2, 1945), 12303; Harry S. Truman, Executive Order No. 9633, 10 *Fed. Reg.* 193 (October 2, 1945), 12035.

<sup>8</sup> Truman also issued a second proclamation that addressed fisheries, "Presidential Proclamation No. 2668, Concerning the Policy of the United States with Respect to Coastal Fisheries in the Certain Areas of the High Seas of 28 September 1945," 10 *Federal Register (Fed. Reg.)* 193 (October 2, 1945), 12304.

of Congress, in which the president pledged political, military, and economic assistance to all nations under the threat of communism, the *de facto* declaration of a global Cold War with the Soviet Union and China. The National Security Act, which restructured the government's military and intelligence agencies, was swiftly moving through Congress. A swelling tide of cheap petroleum imports, furthermore, had undermined experimentation with synthetic fuels and threatened domestic oil production. In 1947, the United States became a net importer of oil for the first time. The Court's conference notes indicate that most of the justices leaned toward bolstering the power and privileges of the federal government during the crisis, not undercutting them. According to Justice Hugo Black, "The federal government has complete power over the waters, the fish, sponges, oil, and all else that is there."<sup>9</sup>

12. In an opinion written by Justice Black, the Supreme Court ruled that the federal government had "paramount rights" in and over the submerged lands below the low water mark, out to and beyond the three-mile belt, off the coast of California. Because the oil and property involved might be necessary for preserving national security and conducting international affairs, Black argued that

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<sup>9</sup> Conference of March 17, 1947 and March 29, 1947, *United States v. California*, 332 U.S. 19 (1947) in Del Dickson, ed., *The Supreme Court in Conference (1940-1985): The Private Discussions Behind Nearly 300 Supreme Court Decisions* (Oxford: Oxford University Press, 2001), 251, 249.

the case should not be judged on the question of “bare legal title.” The United States had rights “transcending those of a mere property owner.”<sup>10</sup> Three years later, on June 5, 1950, the Court issued similar decisions against Texas and Louisiana (*U.S. v. Texas, U.S. v. Louisiana*). “Protection and control of the area are indeed functions of national external sovereignty” and “the marginal sea is a national, not a state concern,” wrote Justice William O. Douglas in the *United States v. Louisiana* majority opinion.<sup>11</sup>

13. After the Supreme Court’s Tidelands’ decisions, the issue moved to the political arena. Coastal states, backed by many state attorneys general, pushed strongly for legislation to “quitclaim,” or return to the states, the federal government’s rights to the marginal sea and its seabed out to three nautical miles from the coast. In 1952, Congress passed such a quitclaim bill, but Truman vetoed the legislation, explaining that he would not approve “a free gift of immensely valuable resources, which belong to the entire Nation, to the States which happen to be located nearest to them.”<sup>12</sup> In a speech to Americans for Democratic Action,

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<sup>10</sup> Supreme Court of the United States, *United States v. California* 332 U.S. 19, June 23, 1947.

<sup>11</sup> Supreme Court of the United States, *United States v. Louisiana* 339 U.S. 699, June 5, 1950.

<sup>12</sup> Harry S. Truman, Veto of Bill Concerning Title to Offshore Lands, May 29, 1952, The American Presidency Project,

Truman added, “They want us to turn the vast treasure over to a handful of states, where the powerful private oil interests hope to exploit it to suit themselves.”<sup>13</sup> Both the Supreme Court and the Truman Administration determined that the federal government was the ultimate authority over the marginal sea and continental shelf, and that federal officials had the responsibility to manage the resources in the greater national interest, not as a “mere property owner” engaged strictly in commercial transactions with oil firms.

14. The parties and candidates in the 1952 presidential election postured around the Tidelands issue – Republican Dwight Eisenhower favoring quitclaim and Democrat Adlai Stevenson supporting Truman’s position. The increasing national security importance of developing domestic oil gave urgency to a speedy resolution of the Tidelands’ controversy. In 1950, oil had replaced coal as the nation’s leading source of energy. War on the Korean peninsula and postwar reconstruction in Europe and Japan placed pressure on global oil supplies, even as the great Middle Eastern oil fields came on stream, and crisis in Iran slowed exports from that nation to a trickle.

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<https://www.presidency.ucsb.edu/documents/veto-bill-concerning-title-offshore-lands-0>.

<sup>13</sup> United States Congress, *Congressional Record*, 82<sup>nd</sup> Congress, 2<sup>nd</sup> Session, Vol. 98, 1952, 625.

15. Upon Eisenhower's victory, coastal state delegations redoubled their drive for quitclaim the minute the 83<sup>rd</sup> Congress went into session. As in the past, the House was expected to pass the measure relatively easily, while the Senate would provide stronger resistance, but would also likely pass the bill with a Republican majority. Advocates of federal control did not surrender meekly. An early indication of this was when, in one of his last acts as president, Truman issued an executive order declaring submerged lands to be a naval reserve. The order was essentially nullified when Eisenhower's attorney general, Herbert Brownell, interpreted it very narrowly to mean the offshore deposits merely passed to the secretary of the navy as custodian, leaving the issue of title unaffected.<sup>14</sup> Nevertheless, the order demonstrated that President Truman, like Roosevelt before him, considered offshore oil and gas to be critical for national defense.

16. In May 1953, after the longest Senate filibuster in history up to that point, Congress passed and President Eisenhower signed the Submerged Lands Act, the first major piece of legislation to cross his desk. While the Act did not recognize specific state claims, it nevertheless quitclaimed to the states all lands permanently covered by tidal waters seaward three nautical miles from the

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<sup>14</sup> "States May Share in Oil Far at Sea," *New York Times* (March 1, 1953). The passage of the Outer Continental Shelf Lands Act formally revoked the executive order.

coastline of each state as the boundary existed when the state became a member of the Union.<sup>15</sup>

17. After returning the three-mile band to the states, Congress passed another bill that reinforced the power, privileges, and paramount rights of the federal government on the OCS beyond three miles. In August, Congress and the President enacted the Outer Continental Shelf Lands Act (OCSLA), which provided that “the subsoil and seabed of the outer Continental Shelf [beyond three nautical miles] appertain to the United States and are subject to its jurisdiction, control, and power of disposition as provided by the Act.”<sup>16</sup> “In order to meet the urgent need for further exploration and development of the oil and gas deposits of the submerged lands of the outer Continental Shelf,” OCSLA authorized the Department of the Interior to grant oil and gas leases and promulgate regulations for their development.<sup>17</sup> OCSLA also assigned United States district courts “original jurisdiction of cases and controversies arising out of or in connection with any operations conducted on the outer Continental Shelf for the purpose of exploring for, developing, removing or transporting by pipeline the natural

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<sup>15</sup> Submerged Lands Act, May 22, 1953, 67 Stat. 29.

<sup>16</sup> Outer Continental Shelf Lands Act, August 7, 1953, P.L. 83-31, 67 Stat., 462.

<sup>17</sup> P.L. 83-31, 67 Stat., 468.

resources, or involving rights to the natural resources of the subsoil and seabed of the outer Continental Shelf . . . .”<sup>18</sup> The fact that Congress assigned federal courts jurisdiction in all matters relating to the OCS indicated a consensus among policymakers that the nation and federal government had a special interest in the oil and gas resources underlying these federal lands.

### **Evolution of the Federal OCS Program, 1954-1970**

18. Using the same division of responsibilities in place for onshore federal lands, Interior delegated management of the OCS to the Bureau of Land Management and the Conservation Division of the U.S. Geological Survey.<sup>19</sup> The BLM prepared the official leasing maps, issued leases and pipeline rights-of-way, and handled all title matter relating to leases. The Conservation Division managed all operational matters, issuing permits for geophysical and geological explorations, collecting rentals and royalties, and policing the operations. With the passage of the OCSLA, the two agencies extended their jurisdiction to mineral leasing offshore. Interior officials, however, had to start from scratch to establish

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<sup>18</sup> P.L. 83-31, 67 Stat., 463.

<sup>19</sup> Marion Clawson, *The Bureau of Land Management* (New York: Praeger Publishers, 1971), 139-141.

governance over an activity with which the federal government had no prior experience or expertise. Therefore, they had little choice but to enlist the service of the oil firms who did. In the spring of 1954, the directors of the BLM and USGS, Edward Wozzley and Dr. W. E. Wrather, conducted conversations with industry and held a series of government meetings and conferences to draw up the regulations.<sup>20</sup>

19. The initial Code of Federal Regulations (C.F.R.), finalized in May 1954, went well beyond those that governed the average federally regulated entity at that time and provided federal officers with the authority to direct lessees' operations. Lessees were required to "comply with the terms of the lease, with the written orders of the supervisor [a representative of the Secretary, under administrative direction of the Director of the U.S. Geological Survey], and, subject to the provisions of section 5 (a) of the act, with the regulations in this part and any amendments thereof."<sup>21</sup> An OCS lease was a contractual obligation on the part of lessees to ensure that all operations "conform to sound conservation practice" (see below) and effect the "maximum economic recovery" of the natural resources on

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<sup>20</sup> Directors, BLM and USGS, to Secretary of the Interior, April 27, 1954, Box 513, CCF, 1954-1958, RG 48.

<sup>21</sup> Geological Survey, Department of the Interior, 19 *Fed. Reg.* 90 (May 8, 1954), C.F.R. §250.30, 2657.

the OCS.<sup>22</sup> “The lessee shall promptly drill and produce such other wells as the supervisor may reasonably require,” according to the regulations, “in order that the lease may be properly and timely developed and produced in accordance with good operating practices.”<sup>23</sup>

20. The OCS regulations gave the Department of the Interior additional powers to direct how oil and gas resources would be extracted and sold from the OCS. The department’s regional supervisor could suspend “any operation or method of operation which endangers life or threatens immediate, serious, or irreparable damage to the leased deposit or other valuable mineral deposits.”<sup>24</sup> The regulations required agency approval of drilling and development programs and all subsequent well operations. Lessees were required to submit all sales contracts to the supervisor, furnish all well logs within 30 days of completing a well, and produce a monthly report of operations. Other requirements included government specifications for “samples, tests, and surveys,” the timing and procedures for well tests, and “well-spacing and well-casing programs.”<sup>25</sup> The supervisor also had the

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<sup>22</sup> 19 *Fed. Reg.* 90 (May 8, 1954), C.F.R. §250.11, 2656.

<sup>23</sup> 19 *Fed. Reg.* 90 (May 8, 1954), C.F.R. §250.33(b), 2657.

<sup>24</sup> 19 *Fed. Reg.* 90 (May 8, 1954), C.F.R. §250.12(b), 2656.

<sup>25</sup> 19 *Fed. Reg.* 90 (May 8, 1954), C.F.R. §250.38, 2659; 19 *Fed. Reg.* 90 (May 8, 1954), C.F.R. §250.14, 2657; 19 *Fed. Reg.* 90 (May 8, 1954), C.F.R. §250.17, 2657.

final say over methods of measuring production and computing royalties, the latter of which was “the estimated reasonable value of the product as determined by the supervisor, with due consideration being given to the highest price paid for a part or for a majority of production of like quality in the same field or area, to the price received by the lessee, to posted prices, and to other relevant matters.”<sup>26</sup>

21. An OCS lease was not simply a contract to explore for oil and gas, but an obligation by the lessee to produce them. In exchange for the “exclusive right and privilege to drill for, mine, extract, remove and dispose of all oil and gas deposits” in a described area, the lessee was required “to drill and produce such wells as are necessary to protect the lessor from loss by reason of production on other properties or, in lieu thereof, with the consent of the oil and gas supervisor, to pay a sum determined by the supervisor as adequate to compensate the lessor for failure to drill and produce any such well.”<sup>27</sup> Primary lease terms were five years. If, at the end of five years, “no well is producing, or is capable of producing, oil and gas in paying quantities from the leased area,” the Secretary of the Interior had the power to cancel the lease and force its surrender back to the government.<sup>28</sup>

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<sup>26</sup> 19 *Fed. Reg.* 90 (May 8, 1954), C.F.R. §250.64, 2659.

<sup>27</sup> 19 *Fed. Reg.* 90 (May 8, 1954), C.F.R. §250.33(a), 2657.

<sup>28</sup> 19 *Fed. Reg.* 90 (May 8, 1954), Lease Form 4-1255, 2666-2667.

Many such non-producing leases were surrendered and often re-leased at subsequent lease auctions to other bidders.

22. The regional OCS supervisor of the Geological Survey's Conservation Division actively managed what became thousands of discretely different OCS leases and operations. OCS regulations were general requirements that rarely, if ever, could be uniformly applied, or complied with, on the OCS. Offshore exploration, drilling, and production were complex and dynamic operations. Each oilfield, each reservoir within each oilfield, and each well within each reservoir was unique. "Each oil well has its own personality, is completely different than the next and has its own problems," observed one offshore consulting geologist in 1970. "I have never seen two wells present identical problems."<sup>29</sup> Moreover, technology in the offshore industry changed rapidly. Operators and contractors continually introduced new equipment and techniques to meet the novel challenges of extracting oil and gas from progressively deeper waters in the ocean, from routine depths of thirty feet in 1954, to 100 feet in 1960, to 500 feet in 1970, to 1,000 feet by 1980. Different water depths, locations, and environmental

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<sup>29</sup> Neil R. Etson to President Nixon, March 18, 1970, U.S. Geological Survey, Central Classified Files, 1968-1974, Box 71, RG 57, Records of the U.S. Geological Survey, National Archives and Records Administration, College Park, MD.

conditions called for different kinds of platform designs, installations, and operations.<sup>30</sup> The regional OCS supervisor and his regulatory staff did not engage in perfunctory, run-of-the-mill permitting and inspection. They constantly had to adapt what they called their “lease management” program to unique and changing circumstances in order to maximize public benefit from OCS hydrocarbon resources.

23. The C.F.R. left substantial discretion to the supervisor in implementing the regulations. Lease operators were required to “exercise reasonable diligence in drilling and producing the wells,” and “carry on all operations in accordance with approved methods and practices.” Operators were obliged to “take all reasonable precautions for keeping all wells under control at all times,” and “take all reasonable precautions to prevent any well from blowing open, including the installation of storm chokes on all producible wells.” They were ordered to “take all reasonable precautions to prevent accidents and fires” and notify the supervisor and submit a full report on any that should occur. In general, lessees were required to “carry on all operations and maintain the property at all times in a safe and workmanlike manner, having due regard for the preservation and conservation of

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<sup>30</sup> Tyler Priest, *The Offshore Imperative: Shell Oil’s Search for Petroleum in Postwar America* (College Station, TX: Texas A&M University Press, 2007), 54-201.

the property and for the health and safety of employees,” and “take reasonable steps” to prevent fire hazards. Regulations also stated that the “lessee shall not pollute the waters of the high seas or damage the aquatic life of the sea or allow extraneous matter to enter and damage any mineral- or water-bearing formation” and “dispose of all useless liquid products of wells in a manner acceptable to the supervisor.”<sup>31</sup> The language of “reasonable precaution,” “approved methods and practices,” “safe and workmanlike manner,” and “manner acceptable to the supervisor” gave wide interpretative latitude to federal OCS officers in determining how they supervised offshore operations.

24. The Geological Survey’s Conservation Division periodically issued “OCS orders,” which were directions and clarifications to all operators on how to meet the requirements in the C.F.R. Between 1958 and 1960, the Conservation Division issued five orders. OCS Order No. 1 specified how wells, platforms, and other fixed structures should be marked. OCS Order No. 2 dictated the minimum depth and methods for cementing well conductor casing in place.<sup>32</sup> OCS Order No. 3 prescribed the minimum plugging and abandonment procedures for all wells

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<sup>31</sup> 19 Fed. Reg. 90 (May 8, 1954), C.F.R §250, 2655-2661.

<sup>32</sup> U.S. Geological Survey, *Monthly Engineering Report*, Conservation Division, Oil and Gas Leasing Branch, Gulf Coast Region, Volume 125 (January-March 1958), RG 57.

drilled “in order to prevent possible migration of oil, gas, or water between formations or to the surface.”<sup>33</sup> OCS Order No. 4 established the conditions under which an OCS lease may be maintained beyond the primary term. These conditions required that at least one well be drilled on the lease and the performance of mandatory “production tests,” under witness of a representative of the Geological Survey, to establish that wells met a minimum flow duration and prove that the wells were capable of producing in “paying quantities.”<sup>34</sup> OCS Order No. 5 required the installation of subsurface safety devices (“storm chokes”) on all OCS wells.<sup>35</sup>

25. Even with the specific stipulations under the OCS orders, the regional supervisor still had to make adaptive and discretionary decisions. Among other issues, these included considering unitization proposals, applications to “commingle” production from different production points, requests for “production

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<sup>33</sup> U.S. Geological Survey, *Monthly Engineering Report*, Conservation Division, Oil and Gas Leasing Branch, Gulf Coast Region, Volume 131 (July-September 1959), RG 57.

<sup>34</sup> U.S. Geological Survey, *Monthly Engineering Report*, Conservation Division, Oil and Gas Leasing Branch, Gulf Coast Region, Volume 132 (October-December 1959), RG 57.

<sup>35</sup> U.S. Geological Survey, *Monthly Engineering Report*, Conservation Division, Oil and Gas Leasing Branch, Gulf Coast Region, Volume 133 (January-March 1960), RG 57.

relief” (see below), and requests for waivers to orders. For example, early storm chokes required by OCS Order No. 5 were very costly and often did not work properly, so the Gulf Region supervisor frequently waived the requirement until the cost and reliability of the technology had improved to a point in the 1970s where Order No. 5 could be strictly enforced.<sup>36</sup> Through the lease management program and the promulgation and revision of OCS orders, the Geological Survey’s regional supervisor exercised active control on the federal OCS over the drilling of wells, the production of hydrocarbons, and the provision of safety.

26. The OCSLA charged the Interior Department with regulating another important realm of offshore activity in the interest of upholding federal rights. Interior retained authority to determine the rate of production from OCS wells. “In order to provide for the prevention of waste, and conservation of the natural resources of the outer Continental Shelf, and the protection of correlative rights therein,” OCSLA authorized the department to write rules providing for the “unitization, pooling, drilling agreements, suspension of operations or production,

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<sup>36</sup> U.S. Geological Survey, *Monthly Engineering Report*, Conservation Division, Oil and Gas Leasing Branch, Gulf Coast Region, December 1958, RG 57; U.S. Geological Survey, *Monthly Engineering Report*, Conservation Division, Oil and Gas Leasing Branch, Gulf Coast Region, February 1960, RG 57; K.E. Arnold, P.S. Koszela and J.C. Viles, “Improving Safety of Production Operations in the U.S. OCS,” OTC 6079, Paper Presented at the Twenty-First Annual OTC, Houston, TX, May 1-4, 1979.

reduction of rentals or royalties, compensatory royalty agreements, subsurface storage of oil or gas in any of said submerged lands, and drilling or other easements necessary for operations or production.”<sup>37</sup>

27. When applied to petroleum resources, the concept of “conservation” did not mean preserving those resources for the use of future generations. It meant extracting the greatest amount of oil and gas that was technologically possible from a finite deposit, while preventing the “waste” of those resources and protecting the property rights, or “correlative rights,”<sup>38</sup> of those affected by petroleum production and its regulation. On the OCS and other federal lands, the general public possessed correlative rights through the representation of the federal government. Waste could take the form of “physical waste,” which was the loss of ultimate oil production through inefficient methods of production,<sup>39</sup> or “economic

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<sup>37</sup> P.L. 83-31, 67 Stat., 464.

<sup>38</sup> The “Correlative Rights Doctrine” in oil and gas is a doctrine applied by the U.S. Supreme Court starting in the early 20<sup>th</sup> century in upholding state statutes prohibiting excessive use and waste of oil and gas in a common pool. The doctrine held that each owner of land that covers a common reservoir is entitled to his or her fair share of the recoverable oil or gas beneath his or her land. A mineral owner’s right to extract oil and gas is limited by the obligation to do so in a way that conserves the resource without waste or negligence. Lewis M. Andrews, “The Correlative Rights Doctrine in the Law of Oil and Gas,” *Southern California Law Review* 13, no. 2 (January 1940): 185-203.

<sup>39</sup> In the 1930s, petroleum engineers considered physical waste to be the result of the “duplication of wells,” which invariably resulted in the smaller ultimate recovery of oil and gas; the “ineffectual and partial use of gas pressure,” which

waste,” which resulted when petroleum production exceeded market demand and thus drove prices below production costs. In spreading the benefits of petroleum production, conservation did “not differentiate between present and future or between producer and consumer.”<sup>40</sup>

28. Without the power of mandatory unitization (combining or merging leases that covered a single field into a single entity) provided by OCSLA to Interior, there was a chance that operators might withdraw oil so rapidly from a multiplicity of wells that they might deplete the reservoir’s pressure or drive mechanism. Production on one lease could “drain” oil and gas from beneath a separately owned adjacent lease or unleased tract, thus reducing the productivity of a reservoir and depriving the government of revenue from lost production over time. Starting in the late 1950s, in addition to approving or requiring unitization, the BLM frequently held special “drainage sales” (as opposed to “general sales”) where it leased OCS tracts that surrounded producing leases in order to protect deposits under those leases from being drained and their value diminished. In

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depleted the “reservoir energy” to bring oil and gas to the surface;” the “flooding of oil sands by water;” and the “failure to extract gasoline from gas.” Harold C. Hanke, “The Need for Conservation of Oil and Gas,” *St. Louis Law Review* 221 (1931): 225.

<sup>40</sup> Dan A. Bruce, “‘Maximum Efficient Rate’ – Its Use and Misuse in Production Regulation,” *Natural Resources Lawyer* 9, no. 3 (1976): 453.

1960, Interior started rejecting bonus bids, even if they were above the minimum required bonus price per acre, if the BLM and Geological Survey regional supervisors determined that such bids were “either too low when compared to the bids offered for offsetting tracts, because of proximity to proven acreage or in an area believed to have greater productivity potential than indicated by the bid.”<sup>41</sup> Officers at the Interior Department thus provided direction to lessees regarding when and where they drilled, and at what price, in order to protect the correlative rights of the federal government as the resource owner and trustee.

29. OCSLA also authorized Interior to “cooperate with the conservation agencies of adjacent states” in regulating hydrocarbon production rates from OCS wells.<sup>42</sup> Under the interstate pro-rationing system coordinated through the Interstate Oil Compact Commission (formed in 1935), oil-producing states limited or “pro-rated” oil and gas production in their jurisdictions below the full “rated potential” of individual wells. This was done in order to match petroleum output to estimated “market demand” and prevent the economic waste of oil and gas from competitive production. The system was called “market-demand pro-rationing.”

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<sup>41</sup> Oil and Gas Supervisor, Gulf Coast Region, to Chief, Conservation Division, Memorandum, April 21, 1961, CCF, 1959-1963, 1960 Sale – Bid Rejection, Box 284, RG 48.

<sup>42</sup> P.L. 83-31, 67 Stat., 464.

Each state issued a maximum “allowable” rate of production for all wells, adjusted monthly for changing conditions of supply and demand. The State of Louisiana also issued well-spacing requirements and monthly “allowables” for wells in state waters (within three miles). Offshore allowables were usually higher than onshore allowables, to compensate for higher fixed costs offshore, but were nevertheless set below full capacity. To ensure the uniform conservation of oil and gas reservoirs that straddled the state-federal offshore boundary or that were within the disputed OCS zones still under litigation (see “interim agreement” below), the OCS supervisor under the Geological Survey directed leases in both the disputed and undisputed zones to produce at allowable rates and under spacing requirements that matched those set by Louisiana.<sup>43</sup> Furthermore, a Supplemental U.S. Supreme Court Decree of December 13, 1965, in the case of *United States v. Louisiana*, required OCS lessees to produce in accordance with Louisiana’s established

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<sup>43</sup> Dean A. McGee, “Economics of Offshore Drilling in the Gulf of Mexico,” *Offshore Drilling* (February 1955): 16; Hollis Dole, Assistant Secretary of the Interior to Senator Edward Kennedy, April 1, 1971, CCF, 1969-1972, Federal Leasing Policy – 1971, Box 135, RG 48. In 1960, Louisiana’s allowable formula gave offshore wells an average bonus of 70 percent compared to onshore wells depending on “depth bracket,” provided additional allowables for wells drilled on units of more than 40 acres, and required a minimum distance between the first two wells drilled in a new pool of 1,320 feet and minimum distance between wells and property lines of 600 feet. U.S. Geological Survey, *Monthly Engineering Report*, Conservation Division, Oil and Gas Operations Branch, Gulf Coast Region, (November 1960), RG 57.

production allowables.<sup>44</sup> The Department of the Interior thus exercised direct control and supervision over the amount of oil and gas that lessees could produce on the OCS.

30. During the 1950s, national security considerations continued to shape the administration of oil and gas production on the OCS. The BLM held three Gulf of Mexico lease auctions in 1954 and 1955 before the State of Louisiana obtained a court injunction against further sales. Louisiana requested a more precise definition of its meandering “coastline” and an explicit determination of the state-federal boundary offshore, as well as a determination of the rights of “ownership,” as distinct from “paramount rights,” over offshore submerged lands.<sup>45</sup> As leasing and drilling were postponed in the Gulf, a major disruption in international oil supply in 1956, caused by Egypt’s nationalization of the Suez Canal, underscored the growing importance of oil supplies close to tidewater ports for U.S. oil security. In other words, the Gulf of Mexico took on new strategic importance for both the United States and the major oil companies at the very moment that the

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<sup>44</sup> 382 U.S. 288 (1965) 294-295.

<sup>45</sup> Gregory Blaine Miller, “Louisiana’s Tidelands Controversy: *The United States of America V. State of Louisiana Maritime Boundary Cases*,” *Louisiana History* 38 (Spring 1997): 203-221.

renewed Tidelands conflict suspended leasing and development.<sup>46</sup> Louisiana and the federal government soon worked out a complicated “interim agreement” that divided the Gulf into zones of overlapping jurisdiction for the purposes of dividing and sharing public revenues from areas contested in court. Offshore oil and gas development, which was strongly desired by both parties, could not go forward without at least a provisional territorial regime to guarantee the security of the massive investments that such development would require. The interim agreement advanced the political and legal process to a point where conflicting claims to submerged lands would no longer limit the pace and scope of offshore leasing.<sup>47</sup>

31. In the late 1950s, the outlook for continued oil extraction from the OCS turned gloomy. An economic recession, an oversupply of crude, a series of hurricanes, and declining oil finds in deeper waters forced a slowdown in offshore exploration.<sup>48</sup> High-cost offshore oil, moreover, could not compete with massive volumes of cheap Middle Eastern oil entering the global and U.S. markets. In

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<sup>46</sup> “Tidelands in Court . . . and in Conferences,” *Oil & Gas Journal* (August 27, 1956): 64.

<sup>47</sup> “Truce Loosens Offshore Straightjacket,” *Oil & Gas Journal* (October 15, 1956): 84-86.

<sup>48</sup> R.O. Frederick, R. O. “Marine Drilling: The Future Remains Bright,” *Drilling* (December 1959): 55-56; Jack Gremillion, *Louisiana Tidelands: A Comprehensive Study* (Baton Rouge: Office of the Attorney General, 1957).

order to protect higher-cost domestic oil from foreign competition, President Dwight Eisenhower in 1959 imposed mandatory quotas, or limits, on oil that could be sold in the United States from abroad. By limiting crude oil imports to 12.2 percent of domestic production, the objective of the quota system was to promote enough of an increase in domestic oil reserves to shield the United States from future foreign supply disruptions.<sup>49</sup> The expansion of oil extraction from the OCS was central to the national goal of displacing imported crude oil with domestically produced oil.

32. Still, even with the imposition of quotas, officials in the federal OCS program decided to give industry more incentives to take risks in exploring offshore. In March 1962, the New Orleans BLM held an unprecedentedly large sale, offering 3.67 million acres for lease, more than all previous four sales combined. Some Texas oil companies and congressmen, however, objected to holding such a large sale. They worried about competition for onshore operations during a time of significant shut-in capacity. In the early 1960s, oil supply in the U.S. market outstripped demand, which prompted state pro-rationing orders to

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<sup>49</sup> Dwight D. Eisenhower, Statement by the President Upon Signing Proclamation Governing Petroleum Imports, March 10, 1959, The American Presidency Project, <https://www.presidency.ucsb.edu/documents/statement-the-president-upon-signing-proclamation-governing-petroleum-imports>; Proclamation 3279, “Adjusting Imports of Petroleum and Petroleum Products into the United States,” 24 Fed. Reg. 49 (March 12, 1959), 1781.

restrict producing wells to an average of 30 percent of capacity. Texas congressman Jim Wright feared that offshore oil development would force the postponement or cancellation of onshore operations. He even went as far as to say that offshore oil development “at this time serves no national interest.”<sup>50</sup> But the Department of the Interior insisted that it was “necessary to develop the technology required to explore, drill, develop and produce oil from extreme water depths in the outer Continental Shelf.” Interior explicitly defended the unusually large sale to reticent Texans in terms of national interest. “Unless some incentive is provided in the form of acreage actually held under lease,” Assistant Secretary John Kelly wrote to Representative Wright, “it seems doubtful that the oil companies and operators would undertake the expense and research necessary to perfect such technology.” Kelly added that “It should be noted that the outer Continental Shelf is part of the United States, and mineral development and production from the shelf properly should be considered an integral part of our overall U.S. production.”<sup>51</sup>

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<sup>50</sup> Representative Jim Wright to Interior Secretary, Stewart Udall, March 2, 1962, CCF, 1959-1963, Box 284, RG 48.

<sup>51</sup> Assistant Secretary of the Interior, John Kelly, to Representative Jim Wright, March 9, 1962, CCF, 1959-1963, Box 284, RG 48.

33. At the March 1962 sale, oil companies acquired almost two million acres of new leases, much of them in unprecedeted water depths.<sup>52</sup> As a result, total offshore oil production from the Gulf of Mexico rose from 127.6 million barrels in 1962 (4.8 percent of total U.S. production) to 334.6 million barrels in 1968 (8.6 percent of the U.S. total), all but about 30 million barrels of this increase coming from federal areas.<sup>53</sup>

34. The value of the federal OCS program to U.S. energy security was further underscored in June 1967, when the Six-Day War between Israel and neighboring Arab states provoked the closure of the Suez Canal and an Arab oil embargo. Although a surge in U.S. oil output from an increase in pro-rationing allowables rendered the embargo ineffective, the curbing of crude exports from some Arab countries nevertheless alerted industry and government about the need to maintain U.S. production capacity in the event of future supply crises. The federal OCS was crucial to ensuring that capacity. “The impact of the OCS fossil fuel development on the national energy complex is becoming increasingly important,” wrote J. Cordell Moore, Assistant Secretary for Mineral Resources, after the 1967 Arab oil embargo. Moore emphasized the tremendous resource

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<sup>52</sup> John W. Pittman, “It's A Boom!” *Offshore* 20, no. 3 (October: 9, 1963).

<sup>53</sup> U.S. Department of the Interior, “Petroleum and sulfur on the U.S. Continental Shelf,” Internal Study, August 1968, CCF, 1969-1972, Box 134, RG 48.

potential of the OCS, not just off Louisiana and Texas, but also off California and Alaska. Particularly important going forward, Moore noted, was “the substitution of offshore sources for onshore and overseas supplies.<sup>54</sup> The Department of the Interior could not have made clearer the value of the OCS to national energy strategy and security, well before the oil shocks of the 1970s.

35. At the same time, OCS officials faced pressure from White House officials to increase revenues from leasing to help plug holes in the federal budget created by expenditures on the Vietnam War. Unlike onshore oil and gas leasing on federal lands, where each state was entitled to 37.5 percent of the revenue from resources extracted within its boundaries, one hundred percent of OCS proceeds were deposited in the federal treasury, under the heading, “miscellaneous receipts.” After the 1967 Louisiana sale, President Lyndon Johnson instructed the Bureau of the Budget (forerunner to the Office of Management and Budget) “to make every attempt to produce additional revenues from Federal resources” and specifically pressed its director, Charles Schultze, about “what might be done to increase revenues from off-shore leasing.”<sup>55</sup>

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<sup>54</sup> J. Cordell Moore, “Challenges and Opportunities on the OCS,” *Our Public Lands* 18, no. 3 (Summer 1968): 18.

<sup>55</sup> Charles Schultze Memorandum for Stewart Udall, November 20, 1967, Tract Evaluation Folder, CCF, 1964-1968, Box 185, RG 48.

36. Congress also took renewed interest in the allocation of OCS revenues.

In July 1968, President Johnson signed a bill sponsored by Washington Senator Henry “Scoop” Jackson to amend the Land and Water Conservation Fund (LWCF) Act of 1964 to double the Fund from \$100 to \$200 million per year and dedicate revenues from offshore leasing to cover the increase. Championed by Interior Secretary Udall, the LWCF had been created to assist States in acquiring and developing “outdoor recreation resources,” such as public parks, and financing the acquisition of new federal lands, such as inholdings within existing national parks or wilderness areas. Henceforth, OCS revenues would become the primary source of funding for the LWCF, whose annual authorized limit steadily increased to \$900 million by 1977.<sup>56</sup> Revenue from offshore oil development was important not just for the general treasury account, but also as a source of funding to protect and conserve other types of natural resources in the United States.

### **The “Acceleration” of OCS Leasing and Development, 1970-1990**

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<sup>56</sup> Margaret Walls, “Federal Funding for Conservation and Recreation: The Land and Water Conservation Fund,” Resources for the Future Backgrounder, January 2009.

37. In October 1968, Under Secretary of the Interior David S. Black traveled to Jackson, Mississippi to give a major policy address to the Gulf Coast Association of Geological Societies, heavily populated by people working for offshore oil firms. After reflecting on the “significant milestones” in the past fifteen years of federal management over the OCS, Black asked a pointed question: “Are the resources being developed at the rate and in the manner that will yield maximum benefit to the total economy, to the regions affected, to national security, and to the public in its proprietary role?”<sup>57</sup> He suggested that they were not. Going forward, Black announced, Interior would begin to undertake more systematic and independent efforts to ensure that the public was receiving more value for its resources. He hinted that “private parties” might be asked to share their “cumulative knowledge” of OCS resources with the government. He also asserted the federal government’s right to impose its own production controls on the OCS, instead of following those set by the states.<sup>58</sup>

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<sup>57</sup> Remarks of Under Secretary of the Interior David S. Black before 18<sup>th</sup> Annual Convention of Gulf Coast Association of Geological Societies, Jackson, Mississippi, October 24, 1968, “The Outer Continental Shelf – Its Promise and Its Problems,” Professional File 1963-69 - OCS Leasing Policy: Required Transmittal of Data, Box 21, Vincent McKelvey Papers, American Heritage Center, University of Wyoming, Laramie, Wyoming.

<sup>58</sup> Ibid.

38. Three months after Black's address, in January 1969, a major blowout occurred on a platform in the Santa Barbara Channel, an event that prompted the first steps in overhauling the federal OCS program and better institutionalizing it as a key component of American energy policy. The Geological Survey revised the OCS orders that had governed lease management, issuing more stringent requirements for mandatory equipment, testing, and operating procedures.<sup>59</sup> It issued new orders prescribing the kind of equipment required for well completions (Order No. 6), procedures for reporting oil spills and disposing of waste (Order No. 7), and design and operation criteria for platforms and structures (Order No. 8) and oil and gas pipelines (Order No. 9).<sup>60</sup> The Coast Guard and the Geological Survey also assumed responsibility for enforcing new regulations issued by the Occupational Health and Safety Administration (OSHA), created in 1970, that

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<sup>59</sup> Department of the Interior, "New Orders Will Regulate Oil, Gas and Sulphur Operations in the Gulf of Mexico," News Release, August 29, 1969, Folder: 1969 – Natural Resources Gas and Oil – Offshore Drilling Regulations, Box 852, T. Hale Boggs Papers, Louisiana Research Collection, Tulane University, New Orleans, LA.

<sup>60</sup> U.S. Department of the Interior, Geological Survey Conservation Division, Gulf of Mexico Area, *OCS Orders 1 thru 12 Governing Oil, Gas, And Sulphur Leases In the Outer Continental Shelf Gulf of Mexico Area*.

established new standards for personnel safety on offshore drilling vessels and facilities.<sup>61</sup>

39. The year 1970 was a major turning point for the OCS program. As federal officials refocused on improving safety, and environmental organizations mobilized to halt offshore leasing and drilling off California, other constituencies began to pressure the government to accelerate OCS leasing. Heating oil supplies ran low during the winter of 1969–1970, and electricity brownouts struck the East Coast the following summer. In August 1970, representatives from the public utilities commissions of nine northeast states met with Secretary of the Interior Walter Hickel to express their grave concerns about future natural gas supplies to their region and suggest that Interior “revise its policies and practices with respect to the petroleum leases” offered offshore. They enumerated their suggestions as follows: 1) “Schedule more frequent sales for potential gas acreage;” 2) “Require accelerated exploration and development;” 3) Stretch out bonus bidding to “reduce the capital barrier to entry” and “share the risk between the government and company;” 4) “Prevent undue delays in production due to extension of leases;” 5) “Require drilling on drainage leases [tracts adjacent to established production]

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<sup>61</sup> Donald J. Solanas, Oil and Gas Supervisor, Pacific Region Memorandum to Chief, Branch of Oil and Gas Operations. U.S.G.S., September 16, 1971, Part 15, CCF 1969-72, Box 137, RG 48.

within 1 year;” 6) “Open new areas promising to gas development;” and 7) “Require expeditious development of unitized leases.”<sup>62</sup>

40. The adequacy of crude oil supplies also concerned public officials. Rapidly increasing demand outstripped available supply and shrank the spare capacity that state regulators and the Interstate Oil Compact Commission had maintained for nearly two decades. In 1971, the United States could provide for just 75.8 percent of the petroleum liquids it needed.<sup>63</sup> By the time Libya and other producing nations in the Middle East began renegotiating their concession agreements with major oil firms and moving to nationalize their reserves, the United States had grown strikingly vulnerable to even a small interruption of

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<sup>62</sup> Alan J. Roth, Executive Assistant to Joseph C. Swidler, Chairman, New York State Public Service Commission to Hollis Dole, Assistant Secretary, Department of the Interior, June 2, 1970, Federal OCS Leasing 1970 – Public Utilities, Natural Gas, Central Classified Files, 1969-1972, Box 135, RG 48; “Suggest for Improving the Supply of Natural Gas – A Basis for Discussion,” Meeting with the Secretary of the Interior, August 11, 1970, attachment to Representative Lowell P. Weicker, Jr., to Walter J. Hickel, August 25, 1970, Federal OCS Leasing 1970 – Public Utilities, Natural Gas, Central Classified Files, 1969-1972, Box 135, RG 48. The nine agencies consisted of the Connecticut Public Utilities Commission, Maine Public Utilities Commission, Massachusetts Department of Public Utilities, New Hampshire Public Utilities Commission, New Jersey Board of Public Utility Commissioners, New York State Public Service Commission, Pennsylvania Public Utility Commission, Rhode Island Public Utilities Commission, and Vermont Public Service Board.

<sup>63</sup> Petroleum and Other Liquids Overview, 1949–2011, *Annual Energy Review 2011*, DOE/EA-0384 (Washington, DC: U.S. Energy Information Administration, September 2012).

foreign oil imports. The “specter of a shortage of energy” loomed on the horizon.<sup>64</sup> In response to possible shortages of both crude oil and natural gas, and addressing the concerns of northeast public utilities, President Richard Nixon directed his Interior Department on June 4, 1971 to rapidly expand industry access to OCS lands for exploration. In what he called the first presidential message on energy ever sent to Congress, Nixon set out a wide-ranging plan, the most consequential of which was its instruction to Secretary of the Interior Rogers C. B. Morton to launch an “accelerated program” of development on the OCS. Nixon ordered an increase in “the offerings of oil and gas leases,” the expansion of leasing beyond the Gulf of Mexico to “other promising areas,” and the issuance of a lease sale schedule for the following five years.<sup>65</sup>

41. The five-year lease schedule was a significant shift in OCS policy. It asserted greater federal power and control over the pace and location of development on the OCS. Whereas in the past, the BLM held general lease sales infrequently and only when officials believed there was enough industry interest, the establishment of a five-year schedule was intended to guarantee that national

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<sup>64</sup> William D. Smith, “Shortages of Energy Continue,” *New York Times* (January 10, 1971).

<sup>65</sup> Richard M. Nixon, “Special Message to the Congress on Energy Resources, June 4, 1971,” in *Public Papers of the Presidents of the United States: Richard M. Nixon, 1971*, 709.

energy needs and priorities were met, above and beyond just those of industry. Eleven days after Nixon's message, Morton released an aggressive five-year schedule that called for twelve lease sales to be held by the end of 1975. In the Gulf of Mexico, two annual lease sales would replace the infrequent and sporadic general sales during the 1960s. Morton also directed the Bureau of Land Management to convene public hearings on the possibility of auctioning tracts—for the first time—off the Atlantic and in the Gulf of Alaska.<sup>66</sup>

42. While the federal OCS program sought to expand lease sales and oil and gas output across the OCS, officials also reasserted federal control over the management of oil and gas production on wells in the undisputed areas of the federal OCS. On December 5, 1970, President Nixon and the Secretary of the Interior ordered the establishment of “the conservation jurisdiction of the Secretary over all lease operations of every kind including rates of production, on oil and gas leases in these areas.”<sup>67</sup> As Under Secretary David Black had warned in 1968, Interior was now claiming independent control over oil and gas production rates on

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<sup>66</sup> Attachment A, “Tentative Schedule—OCS Leasing, June 1971,” in *Final Environmental Statement, Proposed 1972 Outer Continental Shelf Oil and Gas General Lease Sale Offshore Eastern Louisiana* (Washington, DC: Department of the Interior, Bureau of Land Management, June 16, 1972), 346.

<sup>67</sup> Department of the Interior, “Outer Continental Shelf – Conservation Jurisdiction in Undisputed Areas,” 35 Fed. Reg. 236 (December 5, 1970), 18559.

the OCS, rather than coordinating production restrictions with state conservation agencies as it had in the past. Previous directives requiring lessees to comply with conservation rules and regulations of state agencies were rescinded. In place of these, Interior issued OCS Order No. 11 (effective December 5, 1970), which specified, in the ongoing interest of conservation, standards for establishing a government-approved ceiling on the rate of production from OCS oil and gas reservoirs. With state-regulated, market-demand pro-rationing coming to an end, as domestic demand began to outrun domestic production capacity, the regulatory emphasis in conservation at both the state and federal levels shifted away from preventing economic waste to minimizing physical waste.

43. OCS Order No. 11 rested on two standards for guiding the conservation of OCS petroleum resources: 1) the “Maximum Efficient Rate” (MER) of production for individual reservoirs; and 2) the “Maximum Production Rate” (MPR) for each well within a given reservoir. The MER was defined as “the maximum sustainable daily oil or gas withdrawal rate from a reservoir which will permit economic development and depletion of that reservoir without detriment to ultimate recovery.”<sup>68</sup> In other words, MER was a maximum rate of production for

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<sup>68</sup> U.S. Department of the Interior, Geological Survey Conservation Division, Gulf of Mexico Area, *OCS Orders 1 thru 12 Governing Oil, Gas, And Sulphur Leases In the Outer Continental Shelf Gulf of Mexico Area*, January 1975, 11-1-2.

a reservoir that was less than what a reservoir could produce if wells were allowed to flow at their full, naturally driven rate. The use of MER as a regulatory tool went back to World War II, when the Petroleum Administrator for War and state regulatory agencies coordinated conservation measures that included MER.<sup>69</sup> The MPR, by contrast, was the “maximum daily rate at which oil may be produced” from an oil or gas well “completion” (the actions of bringing a well into commercial production).<sup>70</sup> Even prior to OCS Order No. 11, operators were required to submit MPRs for individual wells on the OCS for approval by the supervisor. MER and MPR were related in the sense that “the withdrawal rate from a reservoir shall not exceed the approved MER and may be produced from any combination of well completions subject to any limitations imposed by the MPR established for each well completion.”<sup>71</sup>

44. The newly required MER was a calculated production ceiling that would theoretically enable the largest recovery of oil and gas over the life of the producing formation. OCS Order No. 11 stated that “all producible oil and gas wells and reservoirs may be produced at daily rates not to exceed the Maximum

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<sup>69</sup> Bruce, “‘Maximum Efficient Rate’,” 441-442.

<sup>70</sup> OCS Order No. 11, 11-2.

<sup>71</sup> Ibid., 11-6.

Efficient Rate (MER)," except under specifically approved and temporary circumstances, in order to "provide for the prevention of waste and conservation of the natural resources of the Outer Continental Shelf, and the protection of correlative rights therein."<sup>72</sup> Operators were required to submit a proposed MER from each producing reservoir to the supervisor for approval, as well as test and review the MER annually. The supervisor would then approve any needed adjustments.<sup>73</sup> Operators submitted the first complete set of MERs for the OCS to the Geological Survey regional supervisor for approval in July 1974.<sup>74</sup>

45. MER was a dynamic and imprecise concept that left wide discretion to the supervisor for employing it as a regulatory tool to restrict production from OCS wells. A MER's value depended upon many factors, both engineering and economic, that changed as oil and gas were extracted from a reservoir over time. The key engineering factors were the character of the reservoir and natural drive mechanisms that brought oil and gas to the surface. Mathematical equations and reservoir simulation computer models predicted how a given reservoir would perform over time. Other engineering factors included well performance

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<sup>72</sup> Ibid., 11-1.

<sup>73</sup> Ibid., 11-3-11-4.

<sup>74</sup> Bruce, "'Maximum Efficient Rate,'" 448-449.

characteristics, the number and spacing of wells, platform and pipeline capacities, and maintenance requirements. Economic factors were numerous and subjective: hydrocarbon price; ultimate recoverable reserves (which depended on price); cost of drilling, completion, and production; and other kinds of development decisions.<sup>75</sup> Application of the MER concept often required the curtailment of production rates “when excessive water or gas is produced with the oil so that reservoir energy is conserved.”<sup>76</sup> In other cases, with the regulatory shift from prorated allowables to MER, as Robert Evans, U.S.G.S. Gulf coast regional supervisor, observed in 1971, “We expect some increase in production from certain wells and reservoirs, which were prorated below their maximum efficient rate.”<sup>77</sup> MER added another critical dimension to the lease management responsibilities of the federal OCS regional supervisor.

46. OCS Order No. 11 gave the supervisor a significant degree of discretion in enforcing the new conservation rule. The supervisor could approve the MER for a reservoir from “any combination of well completions subject to any limitations

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<sup>75</sup> Ibid., 449-450.

<sup>76</sup> Hollis Dole, Assistant Secretary – Mineral Resources, Memorandum for John C. Whitaker, Enclosure, January 26, 1971, Federal Leasing Policy – 1971, CCF, 1969-1972, Box 135, RG 48.

<sup>77</sup> Cited in Bruce, “‘Maximum Efficient Rate,’” 450.

imposed by the MPR established for each well completion,” to allow for “excess production” due to “normal variations and fluctuations” in well output, and to give a producer time to bring a reservoir that produced in excess of the MER into “balance.” Operators were required, however, to bring all overproduction into balance “during the next succeeding month.” The order stipulated that an operator with a reservoir “in an overproduction status for two successive quarters which has not been brought into balance within the balancing period shall be shut in from that reservoir until the actual production equals that which would have occurred under the approved MER.” The supervisor also had latitude to allow operators to make up for production (“production relief”) that was lower than the MER: “If, as the result of storm, hurricanes, emergencies, or other conditions peculiar to offshore operations, an operator is forced to curtail or shut in production from a reservoir, the Supervisor may, on request, approve the makeup of all or part of this production loss.”<sup>78</sup>

47. To minimize the waste of resources, OCS Order No. 11 also prohibited the flaring or venting of oil and gas from wells on the OCS. The supervisor, however, also had discretion to approve the flaring or venting of a “small volume”

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<sup>78</sup> Ibid. 11-6-11-7. The supervisor also had the authority to grant production relief under federal-state pro-rationing on the OCS in the event of similar interruptions in production.

or for a “short term” under certain exceptional conditions.<sup>79</sup> These included the release of gas vapors from storage or low-pressure production vessels “if such gas vapors cannot be economically recovered or retained;” the “relief of abnormal pressure systems” during temporary emergency situations; and flaring or venting during the “unloading or cleaning up of a well and during drillstem, producing, or other well evaluation tests not exceeding a period of 24 hours.” The supervisor also had discretion to approve flaring or venting “during routine and special well tests” other than those previously described. Finally, the supervisor was allowed to approve applications for flaring or venting of “oil-well gas” [small amounts of gas produced in association with oil] for a period not exceeding one year if “(1) the operator has initiated positive action which will eliminate flaring or venting, or (2) the operator has submitted an evaluation supported by engineering, geologic, and economic data indicating that rejection of an application to flare or vent gas will result in an ultimate greater loss or equivalent total energy than could be recovered for beneficial use from the lease if flaring or venting were allowed.”<sup>80</sup>

48. Shortly after the issuing of OCS Order No. 11, an inquiry by the Office of Management and Budget asked if, under the current oil and gas supply crisis,

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<sup>79</sup> Ibid., 11-9.

<sup>80</sup> Ibid.

Interior should allow for the “total decontrol of Federal OCS Production levels.”

Interior responded emphatically that federal decontrol would be against national interests in conserving oil and gas resources: “Allowing wells to flow at their maximum capacity regardless of MER would generally yield a loss of some of the resource, if the companies did not themselves move to regulate production in order to protect their investments. An intentional loss of substantial resource would be contrary to orderly resource development. Under no circumstances should there be total decontrol of Federal OCS production levels, if acceptable standards are to be maintained.”<sup>81</sup> In these ways, Interior supervised, directed, and controlled the rate of oil and gas production from reservoirs on the OCS and enforced the federal government’s responsibilities as a resource owner and trustee.<sup>82</sup>

49. Although environmental resistance to expanded OCS leasing emerged on the East and West Coasts (animated by concerns that followed the Santa Barbara blowout), Morton pushed ahead with lease sales in the Gulf and public hearings elsewhere. The energy situation deteriorated over 1972 and into 1973. President Nixon’s advisors warned him in January that the energy crisis was “much deeper,

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<sup>81</sup> Dole, Assistant Secretary – Mineral Resources, Memorandum for John C. Whitaker, Enclosure.

<sup>82</sup> The MER order for the OCS remained the same until 1988, when the MMS revised it to require MERs only on “sensitive” reservoirs, initially defined as “oil reservoirs with associated gas caps.” 53 Fed. Reg. No. 63, 10761.

much broader, much more severe” than anybody realized.<sup>83</sup> In April, Nixon submitted a second major energy message to Congress, in which he announced an end to the mandatory quota system and called again for boosting oil and gas extraction from the OCS. “Approximately half of the oil and gas resources in this country are located on public lands, primarily on the Outer Continental Shelf,” the statement pointed out. Nixon then ordered a second acceleration of offshore oil and gas leasing, directing Rogers Morton to “triple” the acreage leased each year to reach three million acres annually by 1979, starting with expanded sales in 1974.<sup>84</sup> In July, the BLM revised its five-year leasing schedule, increasing the total number of offerings from twelve to fifteen and expanding the leasing map to encompass sales in Alaska’s Lower Cook Inlet and the Bering Sea Strait for the first time.<sup>85</sup>

50. The specter of an oil shortage became reality in October 1973 when the Organization of Arab Petroleum Exporting Countries (OAPEC) embargoed oil shipments to the United States as punishment for U.S. support of Israel in the

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<sup>83</sup> John Connally, Oval Office conversation with President Richard Nixon, January 31, 1973, 4:52 pm, in Douglas Brinkley and Luke A. Nicther, *The Nixon Tapes 1973* (New York: Mariner Books, 2016).

<sup>84</sup> Richard M. Nixon, “Special Message to the Congress on Energy Policy, April 18, 1973,” in *Public Papers of the Presidents of the United States: Richard M. Nixon, 1973*: 306.

<sup>85</sup> “Provisional Outer Continental Shelf Leasing; Provisional Schedule,” 38 *Fed. Reg.* 132 (July 11, 1973), 18473.

Arab-Israeli War. In two November prime-time Oval Office addresses, Nixon called for a national effort—on the scale of the Manhattan Project or the Apollo moon missions—to develop the “potential to meet our own energy needs without depending on any foreign energy sources” by 1980.<sup>86</sup> The specifics behind what Nixon termed “Project Independence” remained unclear until January 23, 1974, when the president sent yet another energy message to Congress. His plan outlined a long list of administrative actions, legislative proposals, and research and development goals similar in substance to what he had first proposed in 1971. The most immediate action Nixon could promise was to further accelerate the production of domestic crude oil. Once again, the federal OCS program was the centerpiece of this effort. The president directed Secretary Morton to “increase the acreage leased on the Outer Continental Shelf to ten million acres beginning in 1975, again more than tripling what had previously been planned.”<sup>87</sup> The Federal Energy Administration-sponsored *Project Independence Report*, published in November 1974, underscored the importance of the OCS by forecasting that a

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<sup>86</sup> Richard M. Nixon, “Address to the Nation About Policies to Deal with the Energy Shortages, November 7, 1973,” in *Public Papers of the Presidents of the United States: Richard M. Nixon, 1973*: 920.

<sup>87</sup> Richard M. Nixon, “Special Message to the Congress on the Energy Crisis, January 23, 1974,” in *Public Papers of the Presidents of the United States: Richard M. Nixon, 1974*, 29.

large percentage of unproven reserves of oil and gas would likely come from accelerated leasing in the OCS frontier areas off the Atlantic, Pacific, and Alaska, and the military exclusion zone in the eastern Gulf of Mexico.<sup>88</sup>

51. Nixon's ten-million-acre announcement was impractically optimistic, and critics raised questions about the OCS program's capabilities to ensure safety and environmental protection under such an aggressive mandate. The passage of major environmental statutes, such as the National Environmental Policy Act (NEPA) of 1969, had transformed the federal role in governing activities that impacted air, water, and land or extracted resources from federal public lands, including, principally, offshore oil and gas. Prior to the OAPEC oil embargo, many bills introduced in Congress went as far as restricting or banning oil and gas extraction on the OCS for environmental reasons.<sup>89</sup> After the embargo, however, the drive for greater national self-sufficiency in energy overtook the political impulse to restrict offshore drilling.

52. Compromise efforts to revise OCSLA proceeded in Congress. Legislators introduced numerous bills in the 93<sup>rd</sup> Congress (1973-1975) to overhaul

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<sup>88</sup> Federal Energy Administration, *Project Independence Report* (Washington, DC: Government Printing Office, November 1974).

<sup>89</sup> "Heavy Backlog of Ocean-Related Bills Stacks up in Congressional Hoppers," *Offshore* (March 1972): 40, 43.

OCSLA. Many aimed essentially to overturn the Tidelands decisions. A proposal from Senator William Hathaway (D-ME) would have redirected 60 percent of the federal take to the adjacent coastal state and given each coastal governor an effective veto on opening its attendant OCS area to oil and gas leasing. Senator Scoop Jackson's Energy Supply Act, the most comprehensive bill of the lot, sought to make OCS oil and gas "available as rapidly as possible," provided it was done with an eye to environmental protection and the return of "fair market value" to the government. Jackson's proposal required permittee disclosure of proprietary geological and geophysical data and directed the Secretary of the Interior to undertake a "survey program" of offshore resources by conducting or contracting out stratigraphic drilling.<sup>90</sup> In January 1975, South Carolina Senator Fritz Hollings introduced a bill that would have further advanced a "federal exploration program" on the OCS. In essence, Hollings called for the creation of a national oil company that would "conduct this program by using the same drilling and exploration firms that are usually hired by oil companies."<sup>91</sup>

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<sup>90</sup> S.2922 and S.3211 in U.S. Senate, "Outer Continental Shelf Oil and Gas Development," *Hearings before the Senate Subcommittee on Minerals, Materials and Fuels, Committee on Interior and Insular Affairs*, 93rd Cong., 2nd sess. (May 6, 1974), 3-111.

<sup>91</sup> United States Congress, *Congressional Record—Senate*, 94<sup>th</sup> Congress, 1<sup>st</sup> Session, January 27, 1975, S903-911.

53. Around the same time, in April 1974, separate hearings took place in the Senate Committee on Commerce on a bill that would have formally established a “Federal Oil and Gas Corporation.” “Fogco” was to be “owned by the federal government” and “in case of any shortage of natural gas or oil and serious public hardship, could itself engage in production on Federal lands in sufficient quantities to mitigate such shortage and hardship.” Fogco would have been allowed to request the right to develop oil and gas on the Outer Continental Shelf, provided it not be granted more than 20 percent of such rights offered for sale or lease. It would have been equipped to employ the “best available geological and geophysical technology” to engage in exploration and also been permitted to store oil and gas in “strategic reserves” for use during an emergency.<sup>92</sup> Some economists at the time believed that this might be the best way to encourage the exploration and development of new reserves.<sup>93</sup> In the end, the Fogco proposal met strong opposition from various quarters of the private sector, but some of the principles that motivated it and other proposed OCSLA reforms found their way into policy.

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<sup>92</sup> U.S. Senate, “Consumer Energy Act of 1974,” *Hearings Before the Committee on Commerce*, 93<sup>rd</sup> Cong., 2<sup>nd</sup> sess. (April 22, 1974), 46-61.

<sup>93</sup> Robert S. Pindyck, “Should the Federal Government Enter the Oil Business?” *Challenge* 19, no. 2 (May/June 1976): 48-51.

54. One was a requirement that OCS lessees share geographical and geophysical (G&G) information with the BLM and Geological Survey. Federal officials had long regarded Interior's lack of such information as the "most serious weakness" of its pre-lease-sale procedures.<sup>94</sup> G&G data was deemed necessary for Interior to evaluate the resource potential of unleased areas of the OCS to be better assured of receiving fair market value for leases sold at auction. Interior did not have the funds to finance its own collection of G&G data or purchase such data from contractors. In June 1976, after many years of study and comment, Interior issued a rule that required operators to submit most of their G&G data and interpretations to the OCS supervisor. In order to protect companies' proprietary interests, most of that data would not be made publicly available until ten years after the issuance of the permit, or as long as the lease remained in effect, whichever was shorter, "unless the Supervisor with the approval of the Director determines that earlier releases of such information is necessary for the proper development of the field or area."<sup>95</sup> The G&G rule was an important step in

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<sup>94</sup> Draft – Outer Continental Shelf Leasing Policy Study, November 20, 1968, Professional File – OCS Leasing Study Draft, Box 21, McKelvey Papers.

<sup>95</sup> Geological Survey, Department of the Interior, 41 Fed. Reg. 122 (June 23, 1976), C.F.R. §250.97, 25893. Exceptions to the rule specified that "information identifying hydrocarbon shows or environmental hazards will be released immediately and information obtained from a deep stratigraphic test would be released five years after completion of the well and, in certain instances, earlier." 41 Fed. Reg. 122 (June 23, 1976), C.F.R. §250.97, 25892.

directing OCS permittees to assist the federal government in assessing the kind, location, and extent of the nation's resources on the OCS.

55. Congressional deliberations to reform OCSLA ruled out giving the government a direct role in exploring for oil and gas on the OCS, but they still reinforced the independent power and authority of Interior over the OCS. A compromise bill finally emerged in the form of the OCSLA Amendments of 1978 (OCSLAA), which was wide-ranging in scope and approved by substantial bipartisan margins in both houses of Congress.<sup>96</sup> Most broadly conceived, the OCSLAA sought to achieve “a proper balance between the potential for environmental damage, the potential for the discovery of oil and gas, and the potential for adverse impact on the coastal zone” when making leasing decisions.<sup>97</sup> Even so, there was no mistaking which of the OCSLAA’s aims was first among equals. Its primary aim was to “result in [the] expedited exploration and development of the Outer Continental Shelf in order to achieve national economic and energy policy goals, assure national security, reduce dependence on foreign

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<sup>96</sup> The Senate voted to approve the conference report 82–7; the House, 338–18, <https://www.govtrack.us/congress/votes/95-1978/s987> and <https://www.govtrack.us/congress/votes/95-1978/h1340>.

<sup>97</sup> Outer Continental Shelf Lands Act Amendments of 1978, P. L. No. 95-372 (1978), 92 Stat. 655, 92 Stat. 650.

sources, and maintain a favorable balance of payments in world trade.”<sup>98</sup> The law’s seemingly more restrictive provisions were put in place to help encourage broad acceptance of this goal. Legislators in the House explained that the stiffening of safety and environmental requirements was a means of reducing red tape, minimizing delays, and providing offshore operators with “greater certainty about the political environment in which they are operating.”<sup>99</sup> Provisions for state and local involvement in federal decision-making were crafted in large part to “limit frivolous lawsuits and expedite all court actions” brought against the Interior Department for resolution.<sup>100</sup>

56. Central to achieving this goal was the OCSLAA’s requirement that the Interior Department set, “as precisely as possible, the size, timing, and location of leasing activity” for a five-year period, in order to “best meet national energy needs.”<sup>101</sup> The requirement of a five-year leasing schedule provided regularity to the offshore program and demonstrated to the industry that the federal government was committed to providing predictable and stable access to the OCS, in order to

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<sup>98</sup> P.L. 95-372, 92 Stat. 631.

<sup>99</sup> House of Representatives, *Report on the Outer Continental Shelf Lands Act Amendments of 1977*, 95<sup>th</sup> Cong., 1<sup>st</sup> sess., H.R. Rep. No. 95-590, at 48 (1977).

<sup>100</sup> Ibid, 50.

<sup>101</sup> 92 Stat 649, 43 U.S.C. § 1344.

promote the growth of offshore operations. As noted above, the idea of a five-year plan had first come about in response to the energy crunch in 1971 to assure that national energy needs and priorities were met. The OCSLAA enshrined this principle into law.

57. The OCSLAA transformed the federal OCS program by adding new provisions that aimed to speed up oil and gas development. The new language regarding a lessee's submission of exploration plans required the Secretary to approve or reject a proposed plan within 30 days of submission.<sup>102</sup> The amendments required the submission of "development production plans" once oil or gas was discovered on a lease for most areas of the OCS, except for the "Gulf of Mexico," where most offshore activity took place, under the rationale that the oil and gas industry in the Gulf of Mexico was mature, and therefore environmental risks were better known than they were in "frontier" regions.<sup>103</sup> Both of these provisions compressed the process of regulatory review in the Gulf in order to shorten the time from lease acquisition to first oil and gas production in the event of a discovery.

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<sup>102</sup> 92 Stat 649, 43 U.S.C. § 1340 (c) (1).

<sup>103</sup> 92 Stat 649, 43 U.S.C. § 1351 (a).

58. The OCSLAA gave the Secretary of the Interior other kinds of decision-making power to meet the national energy goal of accelerating production from the OCS. Although the Act required “the use of the best available and safest technologies which the Secretary determines to be economically feasible, wherever failure of equipment would have a significant effect on safety, health, or the environment,” it also gave the Secretary the authority to make exceptions, when “the incremental benefits are clearly insufficient to justify the incremental costs of utilizing such technologies.”<sup>104</sup> In addition to empowering the Secretary with traditional enforcement actions, such as lease cancellation and criminal and civil penalties,<sup>105</sup> the OCSLAA permitted Interior to prohibit the submission of lease bids “if the Secretary finds, after notice and hearing, that the bidder is not meeting due diligence requirements on other leases.”<sup>106</sup> In other words, if found to be withholding oil and gas from the market by not meeting the obligation to produce from a lease, an operator could be disqualified from bidding in future lease sales. “It seems that in exercising control over public resources, the federal government must be given at least some of the powers of a private landowner to increase

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<sup>104</sup> 92 Stat. 655, 43 U.S.C. § 1347 (b).

<sup>105</sup> 92 Stat. 655, 43 U.S.C. § 1334 (a).

<sup>106</sup> 92 Stat. 655, 43 U.S.C. § 1351 (d).

revenues and manage effectively,” wrote legal analysts about this provision in the amendments.<sup>107</sup>

59. Yet other provisions in the OCSLAA were also designed to increase domestic energy supply. A prohibition on joint bidding ventures between majors, first put into statute by the Energy Policy and Conservation Act (EPCA) of 1975, was reaffirmed in the OCSLAA. The amendments further required the Secretary of the Interior to offer between 20 and 60 percent of OCS acreage in the five years after enactment under a bidding system alternative to the traditional variable-bonus, fixed-royalty method, “unless the Secretary determines that the requirements set for . . . are inconsistent with the purposes and policies of this Act.”<sup>108</sup> While both the joint bidding ban and alternative leasing methods were in part aimed at ensuring the government received fair market value for its resources, their primary goal was to support the continued survival of small and independent operators on the OCS, whose diminished competitiveness in offshore lease sales in the 1970s raised the fears that they would be driven out of the basin, reducing overall drilling and development activity, and thus undercutting domestic oil and

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<sup>107</sup> Robert B. Krueger and Louis H. Singer, “An Analysis of the Outer Continental Shelf Lands Act Amendments of 1978,” *Natural Resources Journal* 19, no. 4 (1979): 921.

<sup>108</sup> 92 Stat. 642.

gas production.

60. The OCSLAA also reaffirmed Interior's right to take royalties paid by lessees "in-kind" and authority to offer this royalty oil to "small or independent oil refiners," again as a way of ensuring competitiveness throughout the larger oil and gas industry. During 1976-1982, Interior collected more than 237 million barrels of crude oil through the Royalty-In-Kind Program and sold it to small refiners who often had difficulty obtaining steady supplies of oil at affordable prices under the system of price regulation in place during that time.<sup>109</sup> The federal government thus played an active role in directing the allocation of crude oil produced on the OCS during the post-embargo energy crises.

61. In the meantime, the Energy Policy and Conservation Act of 1975 shaped the administration of the OCS in other ways as a vehicle for national energy security. In addition to introducing landmark conservation measures, EPCA banned crude oil and natural gas exports from the United States. Thereafter, until December 2015, when the ban was finally lifted, all oil and gas production in the United States (with certain exemptions), including that from the OCS, had to be

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<sup>109</sup> "Interior Sells Offshore Crude to Small Refiners," Minerals Management Service Press Release, October 7, 1983, MMS Press Releases –1980-1983, Box 1, Public Relations Records, Records of the Minerals Management Service, RG 473, U.S. National Archives and Records Administration, College Park, MD.

destined for the U.S. market.<sup>110</sup> EPCA also established the Strategic Petroleum Reserve for storing up to one billion barrels of petroleum in order to shield the United States from “near-term disruptions in supplies of petroleum products or to carry out obligations of the United States under the international energy program” – an idea that had been part of the Fogco proposal.<sup>111</sup> During the 1990s and 2000s, the federal government frequently used OCS royalties-in-kind to replenish the SPR.

62. The federal OCS program’s importance to achieving national energy independence was elevated once again during the renewed energy crisis that engulfed the presidential administration of Jimmy Carter. Mass demonstrations by Islamic forces loyal to the Ayatollah Khomeini in Iran that had driven the Shah of Iran from power in January 1979 resulted in a dramatic reduction in oil exports from that nation. In March 1979, a partial meltdown of a reactor at the Three Mile Island nuclear facility in Pennsylvania reinforced anxiety about energy policy and availability. On April 5, 1979, in his second energy address to the nation from the Oval Office, Carter vowed to “step up exploration and production on Federal

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<sup>110</sup> Public Law 94-163, 89 Stat. 877-878.

<sup>111</sup> Public Law 94-163, 89 Stat. 881.

lands.”<sup>112</sup> Shortly thereafter, Secretary of the Interior, Cecil Andrus, issued a memorandum to the leaders in his department, explaining that the president “has directed me to propose additional acreage to that in the new 5-year OCS leasing schedule . . . . I believe that what the president expects is for us to increase the chances of producing more OCS oil and gas in order to reduce reliance on insecure and expensive imports . . . . I want to be certain that we make the best effort we can to move quickly into frontier areas where the potential for hydrocarbon discovery is highest.”<sup>113</sup>

63. As Carter initiated a phased deregulation of oil prices, American motorists dashed to top off their tanks. Long lines reappeared at gas stations, as they had in 1973, and some states imposed odd-even-day gas rationing. On July 15, 1979, Carter addressed the nation in his “Crisis of Confidence” speech (sometimes referred to as the “malaise” speech), outlining plans to cut oil imports

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<sup>112</sup> President Jimmy Carter, “Energy Address to the Nation,” April 5, 1979, Online by Gerhard Peters and John T. Woolley, The American Presidency Project <https://www.presidency.ucsb.edu/node/249678>.

<sup>113</sup> Secretary of the Interior, Memorandum to Solicitor; Assistant Secretary, Land and Water Resources; Assistant Secretary, Energy and Minerals; Assistant Secretary for Fish and Wildlife and Parks; Assistant Secretary, Policy, Budget, and Administration, Director, Bureau of Land Management; Director, Geological Survey; Director, Fish and Wildlife Service, Subject: President’s Energy Message – Enhance Production from the OCS, April 12, 1979, in U.S. Senate, “OCS Oversight of 1978 Amendments—Part 1,” *Hearings Before the Select Committee on the Outer Continental Shelf*, 96<sup>th</sup> Cong. 1<sup>st</sup> sess. (May 7, 1979), 629.

in half by the end of the 1980s and to promote energy efficiency. He also asked Congress to give him the authority to “cut through the red tape, the delays, and the endless roadblocks to completing key energy projects.”<sup>114</sup> These projects included oil and gas extraction on the OCS. In June 1980, Secretary Andrus approved the first Five-Year OCS Plan under OCSLAA, for the years 1980-1985, which called for 36 lease sales and an acceleration of leasing in “frontier” areas. This amounted to more than seven sales per year, totaling 55 million acres, much more than ever offered before.<sup>115</sup> “The Outer Continental Shelf of the United States represents one of the keys to eliminating the energy dependence which has made us so vulnerable,” said Under Secretary of the Interior James Joseph, before the first meeting of the OCS Advisory Board on December 6, 1979. “Of all our present and potential energy sources oil and gas remain our cheapest, cleanest, most flexible and transportable resource. In this context then the Outer Continental Shelf oil and gas program of the Department of the Interior is important not just to the

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<sup>114</sup> Jimmy Carter, Energy and the National Goals – A Crisis of Confidence, July 15, 1979, American Rhetoric, Top 100 Speeches, <https://www.americanrhetoric.com/speeches/jimmycartercrisisofconfidence.htm>.

<sup>115</sup> U.S. Bureau of Land Management, *Final Environmental Statement, Proposed Five-Year OCS Oil and Gas Lease Sale Schedule, March 1980-February 1985*, (Washington: Department of the Interior, Bureau of Land Management, 1980). During 1954-1969, the DOI had held 1.3 sales per year, increasing to 3.1 sales per year during 1970-1979.

department, not simply to the President, not simply to the industry, but it is important to the American people.”<sup>116</sup>

64. The push to expand and accelerate leasing and exploration of the OCS received new impetus yet again under the Presidential Administration of Ronald Reagan, who took office in January 1981. Reagan’s secretary of the interior, James Watt, immediately implemented a thorough reorganization of the federal OCS program and its leasing system. In 1982, he merged the OCS offices of the BLM and Geological Survey’s Conservation Division into a newly created Minerals Management Service (MMS), in order to assure greater fiscal accountability for royalty collection and to act as a single, coordinated “policy implementing apparatus” for the Outer Continental Shelf and federal lands at large.<sup>117</sup> He also introduced a new system of “area-wide leasing,” which opened entire regional “planning areas” for lease at each sale, as opposed to the rationing of a selected number of industry-nominated tracts in previous sales. “The

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<sup>116</sup> U.S. Department of the Interior, Outer Continental Shelf Advisory Board, Transcript of Proceedings of the Plenary Session of the OCS Advisory Board Meeting, December 6, 1979, Norfolk, VA, 20, Committee and Conference Records, Box 1, RG 473.

<sup>117</sup> Don E. Kash, “Lease Management Activities in the Geological Survey,” Commission on Fiscal Accountability of the Nation’s Energy Resources. National Archives and Records Administration. U.S. Department of the Interior, Technical Reports, 1981–1982, File 239, Box 10, RG 48.

imperative need for an accelerated OCS leasing schedule is the result of too much dependence on imported energy,” testified Interior Assistant Secretary for Policy, Budget, and Administration J. Robinson West.<sup>118</sup> Top officials at Interior expected that area-wide sales would lead to a vibrant rebound of domestic U.S. oil output.

65. Watt’s five-year leasing program (1982-1987) dramatically increased the scale, scope, and pace of the offshore leasing program in an unprecedented way. Whereas the schedule approved by Cecil Andrus in 1980 planned to offer 55 million acres for sale over the course of five years, Watt’s new schedule, which superseded Andrus’s, set out to offer 890 million acres. Interior justified the scheduling of such large sales in nearly every OCS planning area in two ways. First, the new system was necessary for the United States to compete for capital investments in offshore development. Even though offshore production had been pioneered in the Gulf of Mexico, by the end of the 1970s the basin was locked in fierce competition with several offshore markets around the world for exploration and production investment dollars. The United Kingdom and Norway had opened up very large portions of their continental shelves for lease under policies similar to area-wide leasing. Brazil and West African countries also aggressively

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<sup>118</sup> J. Robinson West Testimony, U.S. Congress, House, 97<sup>th</sup> Cong., 1<sup>st</sup> sess., OCS Oversight – Part 2, on OCS Oversight and Related Issues, *Hearings Before the Subcommittee on the Panama Canal/Outer Continental Shelf of the Merchant Marine and Fisheries*, June 2, September 22, and October 28, 1981, 101.

promoted drilling off their coasts and offered lease blocks much larger than the United States.<sup>119</sup> Flows of firms and capital soon followed suit. By the mid-1970s, roughly 75 percent of the globe's offshore drilling rigs were located outside of the United States.<sup>120</sup> The large amount of acreage offered for sale under area-wide leasing drove down the average auction price of bonus bids so that offshore operators could afford to acquire larger lease positions (comparable to those in other countries), in more expensive water depths and locations, and invest the savings in advancing offshore technology.

66. Second, Secretary Watt pointed out that only a very small percentage of promising areas of the U.S. OCS had ever been explored for oil and gas, and thus the nation needed to encourage greater exploration on the OCS in order to “inventory” its offshore resources.<sup>121</sup> In 1981, the USGS, the Rand Corporation, the American Association of Petroleum Geologists, and the National Petroleum Council all submitted estimates of “undiscovered recoverable petroleum resources”

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<sup>119</sup> Harry Wassall, “Government Indifferent to Need for Offshore Oil Exploration,” *Oil & Gas Journal* (May 5, 1980), 221.

<sup>120</sup> “All Offshore Areas of the World Show Gains and Development,” *Offshore* (December 1974): 51.

<sup>121</sup> James Watt Testimony, U.S. Congress, House, 97<sup>th</sup> Cong., 1<sup>st</sup> sess., OCS Oversight – Part 2, on OCS Oversight and Related Issues, *Hearings Before the Subcommittee on the Panama Canal/Outer Continental Shelf of the Merchant Marine and Fisheries*, June 2, September 22, and October 28, 1981, 49.

to the new administration, and all pointed to areas on the federal OCS as holding the most promise.<sup>122</sup> “Here we face the decade of the 1980s,” Watt testified before Congress in June 1981, but we “do not know the extent of our mineral potential within the continental United States.” Watt added, “The President is vitally interested in the development of national energy self-sufficiency, and views acceleration in offshore leasing as an integral part of his economic recovery program.”<sup>123</sup> The recruitment of oil and gas firms in helping to inventory the OCS thus had both larger security and economic objectives.

67. The other notable policy shift under Reagan that enabled the expansion of offshore drilling was the extension of U.S. sovereign claims over larger marine territory. In March 1983, two months before the first area-wide lease sale in the Gulf of Mexico, President Reagan provided a more secure legal and political foundation for the new system. Presidential Proclamation 5030 declared a 200-mile “Exclusive Economic Zone” (EEZ) along the entirety of the U.S. continental

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<sup>122</sup> American Association of Petroleum Geologists, Select Committee on the OCS, Report on Expediting the Development of Petroleum Resources on the U.S. Federal Offshore, Submitted to the Honorable James G. Watt, Secretary of the Interior, May 26, 1981, RH MS 546, Box 47:2, Hollis Hedberg Papers, Kansas Collection, University of Kansas Libraries, Lawrence, KS.

<sup>123</sup> Watt Testimony, OCS Oversight – Part 2, on OCS Oversight and Related Issues, 49.

margin.<sup>124</sup> Reagan based his authority for this proclamation on the newly codified Law of the Sea convention. Completed in 1982, the third United Nations Law of the Sea Conference had produced a convention that allowed coastal nations to claim a legal continental shelf out to 200 nautical miles, even if the geologic continental shelf did not extend that far, and it created a process by which states could extend their continental shelf beyond 200 miles based on certain geographic and geologic criteria. Member nations could assert an “exclusive economic zone” over their continental shelf, where they retained “sovereign rights for the purpose of exploration and exploiting, conserving and managing the natural resources, whether living or non-living.”<sup>125</sup> The new U.S. EEZ formally expanded U.S. rights beyond the edge of the continental shelf, where the U.S. government was pushing oil companies to explore for new reserves. Although the United States had played an instrumental role in shepherding the Law of the Sea Convention to passage in the United Nations, Reagan did not sign it, largely because of strong objections to its provisions for the global sharing of deep sea-bed minerals located beyond the

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<sup>124</sup> “Proclamation 5030—Exclusive Economic Zone of the United States of America,” 48 *Fed. Reg.* 48 (March 10, 1983), 10605.

<sup>125</sup> United Nations Convention on the Law of the Sea, December 10, 1982, 1833 U.N.T.S., 418.

EEZs.<sup>126</sup> Nevertheless, Reagan's declaration of the EEZ certified the territorial integrity under international law that oil and gas firms needed before committing to billion-dollar investments in deeper waters.

68. The U.S. policy of area-wide leasing under the new EEZ framework transformed U.S. offshore energy development in two ways. First, it made it possible for oil companies to invest in more expensive, deeper waters to search for oil and gas. Not until companies possessed such extensive acreage did they have the incentive to develop and refine advanced technologies that they had on their drawing boards. Without such lease inventories, boards of directors would not have approved the large capital outlays needed to test new concepts for deepwater drilling and production. After the oil price collapse of 1985-1986, the MMS gave further impetus to deepwater exploration by lowering the minimum bonus bid for all leases in water depths past 400 meters from \$150/acre to \$25/acre.<sup>127</sup> The softening of demand for crude and a series of lackluster sales between 1986 and 1987 convinced officials that the higher minimum bid level was an “undue

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<sup>126</sup> George D. Haimbaugh, Jr., “Impact of the Reagan Administration on the Law of the Sea,” *Washington & Lee Law Review* 151 (Winter 1989), <https://scholarlycommons.law.wlu.edu/wlulr/vol46/iss1/6>.

<sup>127</sup> Minerals Management Service, Outer Continental Shelf Oil & Gas, 5-Year Leasing Program Mid-1987 to Mid-1992, Proposed Final, April 1987, 16.

constraint” on the industry.<sup>128</sup> Interior’s administration of the area-wide leasing system enabled firms with novel strategies for seismic exploration and deepwater production to thrive in the economically challenging low-oil-price climate of the mid-1980s and 1990s.

69. The reform of the leasing system led to major discoveries in the deepwater Gulf (deeper than 400 meters or 1,300 feet of water) by the late 1980s, the development of which reinvigorated the entire oil and gas complex from Brownsville, Texas to Pascagoula, Mississippi in the 1990s. Once derided as the “Dead Sea” after a twenty-year decline in production, the Gulf of Mexico emerged in the 1990s as one of the hottest plays in the world.<sup>129</sup> The area-wide leasing reform of the early 1980s accomplished what its designers had intended, which was to stimulate a vibrant market for leases, spur investment, and enlarge domestic sources of oil and gas.

70. The second transformation spurred on by area-wide leasing was an onslaught of litigation that challenged the expansion of offshore leasing as a threat to the environmental and recreational health of American coastlines. As coastal states outside the Gulf of Mexico and environmental organizations lost major legal

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<sup>128</sup> “More Incentives Are Needed to Bring Forth Frontier Oil,” *Offshore* (March 1986).

<sup>129</sup> Priest, *The Offshore Imperative*, 180-226.

challenges to the Andrus and Watt five-year plans in federal court, they turned to legislative fixes to inhibit or prevent the expansion of offshore drilling beyond the Gulf of Mexico. Starting in Fiscal Year 1982, coastal-state congressional representatives began attaching riders or limitation clauses on annual appropriations bills that emerged from the House, restricting Interior's activity along parts of the OCS. Congress progressively expanded its "moratoria," withdrawing increasingly large portions of OCS acreage every year until 1990, at which point virtually the entire Atlantic and Pacific coasts were off-limits to development. Acreage withdrawals were put in place over most of the eastern Gulf of Mexico in 1984, and smaller amounts taken off the table over Alaskan waters starting in 1989. In 1990, President George H.W. Bush issued an executive withdrawal of OCS lands off both coasts until 2000, under the authority of the Antiquities Act. President Bush also delayed and canceled several lease sales planned for 1989 and 1990 off California and Florida and initiated the buy-back of leases in the eastern Gulf of Mexico. In 1998, President Clinton extended the Bush moratorium through 2012.

71. During the 1970s and 1980s, the vast majority of organized opposition to offshore drilling in the United States did not focus on climate change. Rather, opposition centered on concerns about the threat of oil spills to coastlines, marine life, and the communities that depended upon them. After James Hansen, chief

scientist at NASA's Goddard Institute for Space Studies, testified before the Senate in June 1988 on the subject of climate change, the Department of the Interior immediately formed a high-level working group to examine how action to address the issue might impact the department's resource management and responsibilities. MMS director, William Bettenberg, informed the deputy assistant secretary for land and minerals management in Interior that action to address climate change would most likely shift energy use from coal to cleaner-burning oil and gas, and therefore result in greater demand for hydrocarbons from the OCS.<sup>130</sup>

### **The Renewal of the OCS, 1990-2015**

72. As large sections of the U.S. OCS were closed off to leasing and drilling, the federal OCS program in the early 1990s focused on the one proven OCS province that was still open -- the central and western Gulf of Mexico -- as the most likely place to expand U.S. domestic oil and gas reserves. By this time, the

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<sup>130</sup> Deputy Assistant Secretary for Land and Minerals Management (Griles) to Directors of MMS, BLM, OSMRE, July 28, 1988, Request for Assistance on Climate Change Issue; and Director, MMS (Bettenberg) to Deputy Assistant Secretary – Land and Minerals Management, August 22, 1988, ENV 4 – Environmental and Ecological Data Collection, FY 1988, Box 1, Mission Subject Files 1987-1988, UD-10W7, Records of the Minerals Management Service, RG 473.

offshore oil industry was suffering under low crude oil prices. Production of oil and natural gas from the Gulf of Mexico was in decline, and proven reserves in the United States as a whole were also trending downwards. Unemployment in the petroleum-rich regions of Louisiana had reached 20 percent after the price crash in 1986. Industry supporters in Congress and the MMS searched for ways to provide incentives to companies that had discovered deepwater hydrocarbon deposits, thanks in part to the area-wide leasing reform, but which could not afford the massive capital investments needed to develop those discoveries. In August 1992, Louisiana Senator Bennett Johnston introduced the “Outer Continental Shelf Deep Water Production Incentives Act,” which amended Section 8 of the OCSLAA to allow the Secretary of the Interior to exempt royalty payments on oil and gas production from deepwater leases (200 meters or greater) “until the capital investment costs related to such production have been recovered by the lessee out of proceeds from such lease.”<sup>131</sup>

73. Minerals Management Service director, Scott Sewell, testified before Johnston’s committee in 1992 that he had grave concerns about the viability of continued oil and gas growth in the Gulf of Mexico. Recent lease sales—still held

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<sup>131</sup> U.S. Congress, Senate, “Outer Continental Shelf Deep Water Production Incentives Act,” S. 3127. *Hearings Before the Committee on Energy and Natural Resources*, 102nd Cong., 2nd sess., August 11, 1992.

under the area-wide approach—had deeply disappointed those in the agency, as bonus bid revenues fell to near-historic lows. Sewell explained, “I do not think anybody expected really how far things have fallen and how bad the situation has gotten . . . particularly in the Gulf of Mexico, which is really the bread and butter of the entire OCS program.”<sup>132</sup> Sewell estimated that as much as 50 percent of deepwater discoveries not already producing could become newly economical if given an additional financial incentive.<sup>133</sup> Sewell also expressed one concern that added another dimension to the debate: he feared that a sustained slump in the deepwater exploration and production market could gut the entire offshore industry in the United States. Such an occurrence would be detrimental to domestic energy and national security alike. Speaking to the job losses suffered in the Gulf of Mexico since the mid-1980s, Sewell said, “A decline of this magnitude poses long-term dangers to the industry and its ability to recover. Even if the operating outlook of the industry were to improve dramatically, it would take many years to reacquire the specialized scientific, engineering, and technical skills of the people that have moved out of the industry over the last decade.”<sup>134</sup> Even though crude

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<sup>132</sup> Testimony of Scott Sewell, U.S. Congress, Senate, Outer Continental Shelf Deep Water Production Incentives Act, *Hearings Before the Committee on Energy and Natural Resources*, 102nd Cong., 2nd sess., August 11, 1992, 20.

<sup>133</sup> Ibid., 23.

<sup>134</sup> Ibid., 17.

oil supplies appeared abundant and prices low, the MMS and Interior Department were concerned about the ability of the oil industry to maintain the technological capacity to ensure adequate domestic petroleum supplies in the future.

74. After several years of congressional and executive deliberation, President Bill Clinton in November 1995 signed the Deep Water Royalty Relief Act (DWRRA) into law.<sup>135</sup> The DWRRA amended Section 8(a) of the OCSLA to authorize the Secretary of the Interior to offer royalty suspensions up to a certain production volume on “producing or non-producing” leases as well as new leases in 200 meter water depths or greater in the Western and Central Planning Areas of the Gulf of Mexico. The Act gave the Secretary the sole power to “determine” whether new production from existing leases “would be economic in the absence of the relief from the requirement to pay royalties.”<sup>136</sup> The application of royalty suspensions to existing leases was another indication that the lessee-lessor relationship was not merely an arms-length transaction. The Secretary of the Interior had the power to adjust the value of hydrocarbons that existed under those leases to ensure that those resources could be produced under the terms of the lease. Section 201.90 of the C.F.R. had vested the power to grant royalty and

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<sup>135</sup> Title III of P.L. 104-58, 109 Stat. 557.

<sup>136</sup> Ibid.

rental relief with the Secretary, “in order to increase the ultimate recovery of minerals and in the interest of conservation,” but the DWRRA specified in statute how this could be applied in the deepwater Gulf of Mexico.<sup>137</sup>

75. Although the administration of the DWRRA later became embroiled in lawsuits, the policy nevertheless helped to stimulate a boom in deepwater leasing, attract billions of dollars in new offshore investment, and fuel the growth in deepwater oil and gas production in the Gulf of Mexico.<sup>138</sup> Deepwater oil output soared from negligible amounts in 1995 to nearly a million barrels/day in 2004, fast replacing sharp declines in shallow water.<sup>139</sup> In the early 2000s, oil and gas from the Gulf of Mexico rose to supply close to one-third of U.S. domestic production, surpassing both onshore Texas and Alaska in crude oil. The growth of deepwater oil and gas output in the Gulf of Mexico came at an auspicious moment, as declining production elsewhere in the United States and the tightening of global crude supplies fostered rising concerns about American energy security and

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<sup>137</sup> 19 Fed. Reg. 90 (May 8, 1954), C.F.R §250.90, 2665.

<sup>138</sup> Andrew B. Derman and Daniel Johnston, “Royalty Relief Extension Vital for Continued Deepwater Development,” *Oil & Gas Journal* (May 8, 2000).

<sup>139</sup> Mike Celata, Regional Director, Gulf of Mexico Region, “Deepwater Gulf of Mexico,” November 9, 2017, <https://www.boem.gov/sites/default/files/boem-newsroom/BOEM-Deepwater-Operation-Presentation.pdf>.

independence. Those concerns intensified as international oil prices climbed steadily to over \$140/barrel by June 2008.

76. During this period, the federal OCS program looked to offshore Alaska – the only other place on the OCS not under moratoria – to shore up domestic energy production. In 2007 and 2008, the MMS auctioned leases in the Beaufort Sea off Alaska, and then in 2008 collected a surprising \$2.66 billion in bonuses for leases in the Chukchi Sea. After these sales, political support to expand offshore leasing and drilling outside the Gulf of Mexico gathered momentum, making the OCS a headline issue in the presidential election campaign of 2008. In July, President George W. Bush lifted the presidential moratorium on offshore drilling along vast sections of the U.S. Outer Continental Shelf introduced by his father, President George H.W. Bush, and extended by President Bill Clinton. That same month, the U.S. Geological Survey issued a “Circum-Arctic Resource Appraisal,” in which it placed undiscovered Arctic oil resources at 90 billion barrels (13 percent of the world’s undiscovered oil) and natural gas reserves at 1,669 trillion cubic feet of gas (30 percent of the world’s undiscovered gas), and 44 billion barrels of natural gas liquids. The amount estimated for the U.S. portion of the Circum-Arctic was 22 billion barrels of oil and 93 trillion cubic feet of gas.<sup>140</sup>

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<sup>140</sup> U.S. Geological Survey, U.S. Department of the Interior, “Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic

Then, in September 2008, House Democrats allowed the long-standing congressional moratorium, in the form of annual riders to Department of the Interior appropriations, to lapse in the hopes of achieving a compromise with offshore drilling proponents that would lead to broader energy policy reform.<sup>141</sup>

77. This strategy carried over into the next presidential administration. On his last day in office, President Bush released for public comment a Draft Proposed Program for the 2010-2015 five-year plan, unusual in that it sped up the next five-year plan to overlap with the existing 2007-2012 plan. The new plan included lease sales in four areas off Alaska, two areas off the Pacific coast, three areas in the Gulf of Mexico, and three areas in the Atlantic. Shortly after Barack Obama took the oath as President, Secretary of the Interior Kenneth Salazar announced his offshore energy policy, which included an extension of the comment period on Bush's Draft Proposed Program. Meanwhile, in December 2009, Salazar approved a plan for three exploration wells in the Chukchi Sea in the summer of 2010.

78. On March 31, 2010, President Obama, as part of an “expanded energy

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Circle,” USGS Fact Sheet 2008-3049 (2008),  
<http://pubs.usgs.gov/fs/2008/3049/fs2008-3049.pdf>.

<sup>141</sup> The exception to the removal of the moratorium was the Eastern Gulf of Mexico. In 2006, Congress banned leasing within 125 miles or more of Florida's gulf shores until 2022, opening more than eight million acres of the Gulf acreage to new leasing in exchange for bigger shore-buffer protection.

development” program, scaled back the Bush administration program, including a revised 2007-2012 plan that cancelled five Alaska lease sales, postponed a lease sale offshore Virginia (moved from the 2007-2012 plan to the 2012-2017 plan), and removed leasing in the Pacific from consideration. But Obama’s revised five-year OCS plan for 2012-2017 also left open the possibility for leasing in the Eastern Gulf of Mexico, the Chukchi and Beaufort Seas, and the Mid- and South-Atlantic. In his announcement, Obama emphasized a point that had preoccupied every presidential administration since the Second World War – that “our dependence on foreign oil threatens our economy.” Highlighting the need to shift away from fossil fuels entirely, Obama also cautioned that “we are going to need to harness traditional sources of fuel even as we ramp up production of new sources of renewable, homegrown energy.” This is why, he stated, “we’re announcing the expansion of offshore oil and gas exploration, but in ways that balance the need to harness domestic energy resources and the need to protect America’s natural resources.”<sup>142</sup> As it had for at least six decades, the federal OCS still filled a vital need for the U.S. government in securing oil and gas resources to make the nation more energy independent.

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<sup>142</sup> “Text of Obama’s Remarks on Offshore Drilling,” *New York Times* (March 31, 2010), <https://www.nytimes.com/2010/04/01/science/earth/01energy-text.html>.

## Conclusion

79. The U.S. federal OCS program is the longest-running policy regime for offshore leasing, drilling, and production in the world. For more than six decades, it has been a major engine of wealth creation for the U.S. economy and source of revenue for the federal government. By creating abundant and reliable domestic sources of oil and gas, it has bolstered U.S. energy security and independence and continues to do so today. Federal OCS officials achieved this by actively directing the terms of access, locations, methods and pacing of development, and rates of production from the publicly owned resources on the Outer Continental Shelf.

Starting in the 1980s, the federal government also closed off the majority of the federal OCS to leasing and drilling, in a quest to strike a balance between environmental protection and the “expeditious” development of oil and gas in those parts of the OCS that remained open. The challenging purpose of the OCS program, ultimately, has been to direct private activities to ensure public welfare and manage public lands and resources on the OCS for current and future generations of Americans.

I declare under penalty of perjury that the forgoing is true and correct. Executed on February 24, 2021.

*Richard Tyler Priest*

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Richard Tyler Priest